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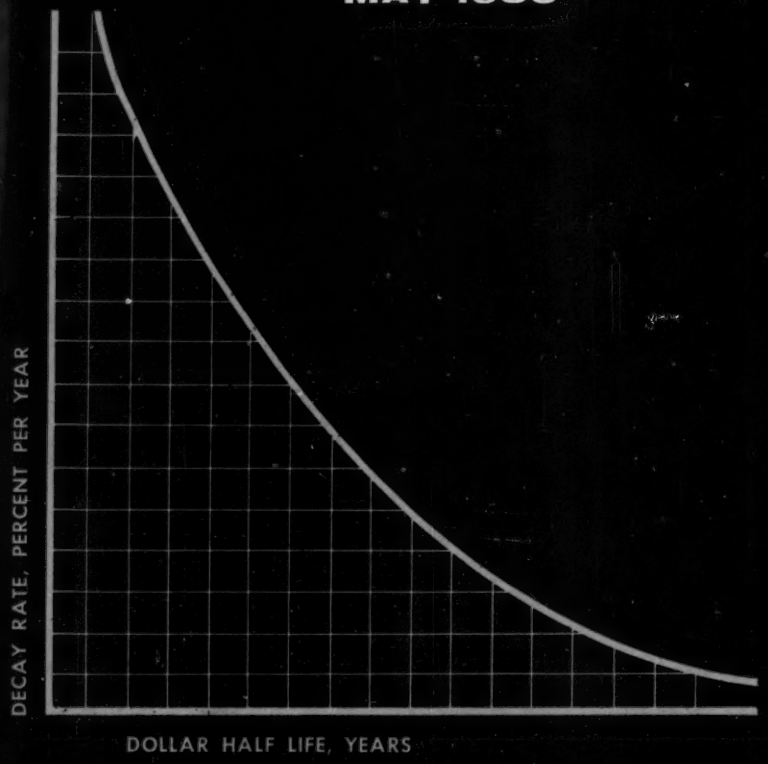
Chemical Engineering

MAY 1956



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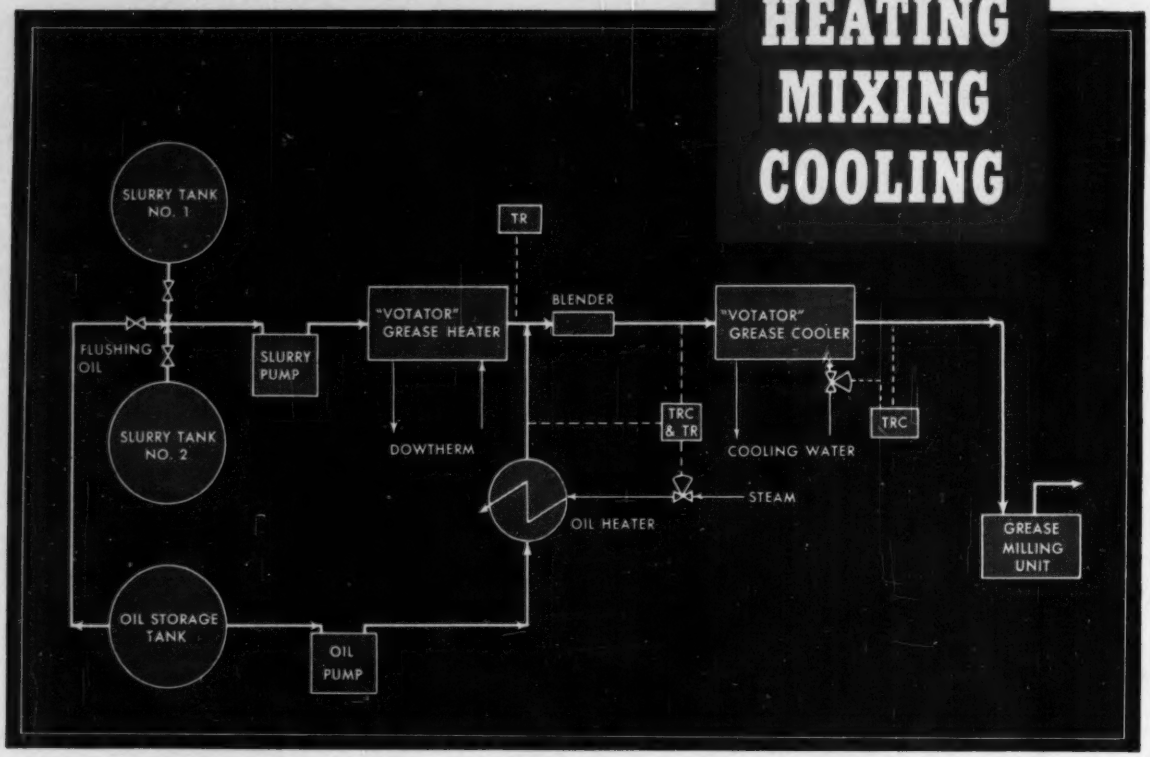
HEATING MIXING COOLING



How *Votator*® Heat-Transfer Apparatus produces better grease at lower cost

MANUFACTURERS of lithium stearate grease report these important benefits by changing from the open-kettle method to *continuous, enclosed processing* with VOTATOR* Heat-Transfer Apparatus:

- **Higher production rate**
- **Lower labor cost**
- **Lower soap costs**
- **Less floor area required**
- **More uniform consistency and color**
- **No fire hazard—permits use of low-flash oils**
- **Better housekeeping**

Heating, mixing and cooling are performed as shown in the flow diagram. Write today for further information on this profitable processing method. The Girdler Company, Votator Division, 224 East Broadway, Louisville 1, Kentucky.

*VOTATOR—Trade Mark Reg. U. S. Pat. Off.

the **GIRDLER** Company

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

LOUISVILLE 1, KENTUCKY

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MAY 1956

JOHN R. CALLAHAM, Editor

Next Month: Compression

If you're concerned in any way with compression and the handling of compressible fluids, you'll be interested in next month's 64-page report on this subject.

This June report will give you a broad picture of the field.

It will also provide plenty of practical information on (1) where and how compressible fluids are used in today's chemical processing, (2) what factors you should consider in selecting your compressors, (3) the characteristics and limitations of each type of compressor.

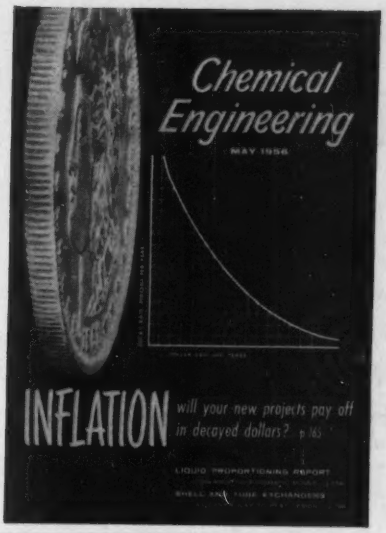
In the section dealing with selection, for instance, our authors will discuss such factors as gas properties, process conditions and energy sources. And there'll be practical examples to show how all these have to be balanced out.

Types of compressors that will be described include steam jets, mechanical high-vacuum pumps, reciprocating compressors and vacuum pumps, fans, centrifugal compressors, rotary compressors and vacuum pumps, axial compressors.

Costs — initial and operating — will be discussed. And there will be data on operating principles, pressure range, limitations, size, capacities, and optimum performance of each compressor type.

This special report on compression, developed by request, is designed to fill a big gap in the chemical engineering literature.

Watch for it—then let us know how it fills the bill.



GUIDED TOUR

What happens to your cost comparisons when the dollar starts shrinking?

Capitalized cost comparison is still the sound and simple basis for placing costs on a common basis. But it isn't enough. It has to be modified. You can now predict what a shrinking dollar will do. For the first time inflation appears in the formulas for cost analyses. (p. 165)

An expert looks at nitric acid

To update your appreciation of one of our best chemical barometers, we've a critical comparison of the three processes most important now. How they work, costs, investment, advantages. (p. 170)

Proper feeding for processes

Accuracy of feeding is a "must." It's a growing must, too, as process industries

Please turn page

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GUIDED TOUR

strive toward continuous operations. Your CE Report highlights latest methods and equipment for continuous feeding and/or metering of your process liquids. (p. 175)

How to pinpoint performance

Here's how to derive some performance indexes of your own. They're based on standard costs. And they can become an important help in managing your materials, equipment and your men. (p. 189)

To design the optimum exchanger

Here's an answer to one part of today's rising costs. New simplified equations will give you the best heat exchanger design for your money. They're based on minimizing annual costs. (p. 196)

Unscramble binary mixtures faster

New circular nomograph helps you to estimate vapor-liquid equilibrium values for binary mixtures. Easy, fast, accurate. It's good, too, for interrelating weights, volumes, mole fractions. (p. 201)

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To keep pace with the chemical, petrochemical and chemical process industries, more engineers subscribe to Chemical Engineering than to any other publication. Total net paid circulation of this issue:

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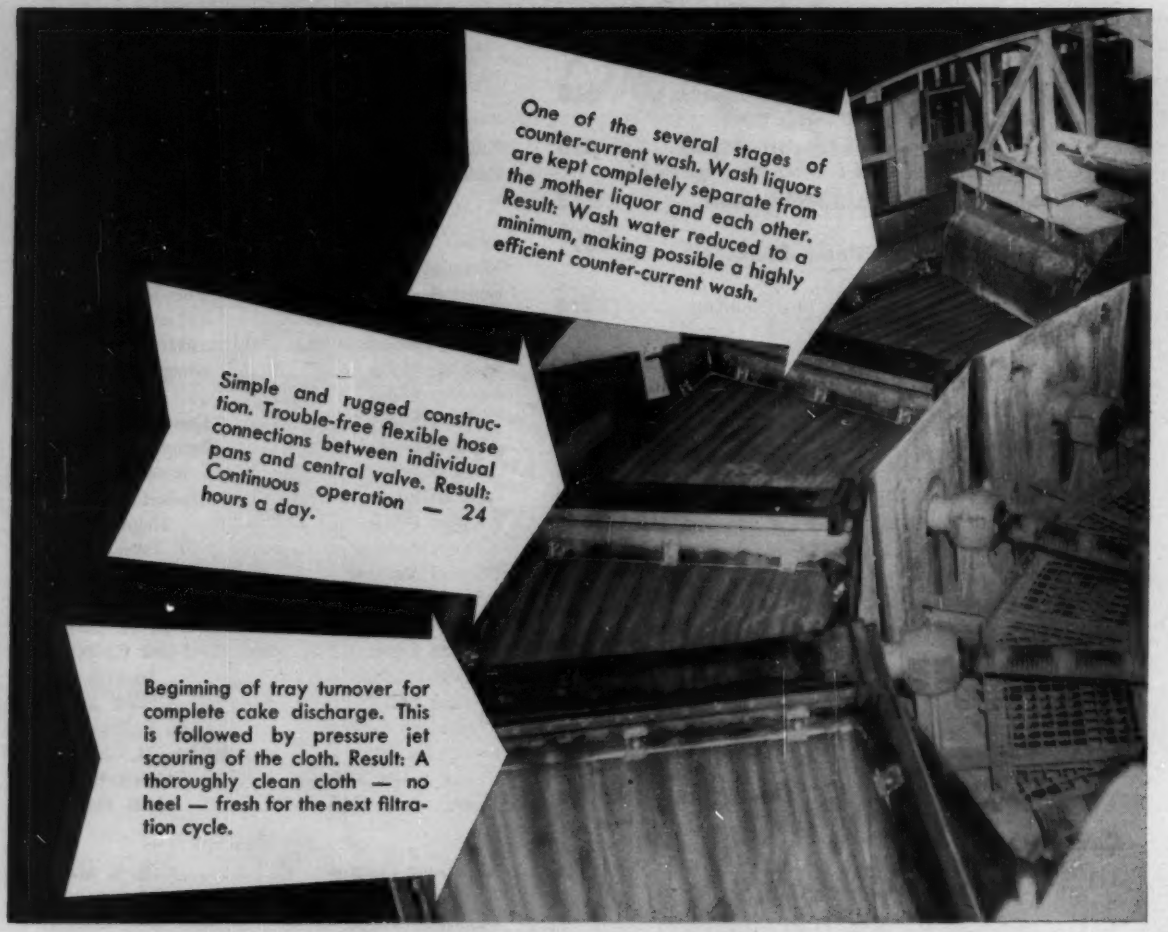

One of the several stages of counter-current wash. Wash liquors are kept completely separate from the mother liquor and each other. Result: Wash water reduced to a minimum, making possible a highly efficient counter-current wash.
Simple and rugged construction. Trouble-free flexible hose connections between individual pans and central valve. Result: Continuous operation — 24 hours a day.
Beginning of tray turnover for complete cake discharge. This is followed by pressure jet scouring of the cloth. Result: A thoroughly clean cloth — no heel — fresh for the next filtration cycle.

Performance and Operating Economy reach new heights with the

BIRD-PRAYON

CONTINUOUS, ROTARY, HORIZONTAL, VACUUM

FILTER

The features shown above tell, in part, why the Bird-Prayon Filter is arousing so much interest in plant and front office alike. It provides a new approach to the problem of filtering and washing coarse or heavy materials, metallic concentrates or solids that tend to blind filter cloths. The results are performance and operating economy beyond the reach of previous filters.

Get the whole story on this remarkable Filter. Write for new Bulletin and let us show you how easily you can obtain pilot-scale test data.

BIRD

Leading Authority on Solids-Liquids Separations

Builders of
- Bird Continuous Centrifugal Filters
- Bird-Prayon Continuous, Rotary, Horizontal Vacuum Filters
- Bird-Young Continuous Rotary Vacuum Filters
- Bird Horizontal Tank, Vertical Leaf Pressure Filters
- Bird-Humboldt Screen Type Centrifugal Dryers
- Bird Suspended Centrifugals • Bird Centrifugal Classifiers
- Bird Continuous Centrifugal Coal Filters • Bird Polishers
- Bird Centriwasps for delicate Crystals, Fibrous Materials

For specific information on individual machines write Bird Machine Company, South Walpole, Massachusetts
Regional Offices: Evanston, Illinois • Portland, Oregon

NEW CONVEYOR BELT IDLER

Handles sticky, abrasive, dusty, or corrosive materials.

Has only two bearings—up out of the dirt.

A 2-bearing, cable suspension idler that resists dust, abrasion, corrosion and material buildup is proving itself superior for bulk handling in many industries.

Called the Limberoller, it has already given *11 times* the service life of replaced steel idlers in handling abrasive foundry sands, coal, petroleum coke, potash, copper ores, copper mill tailings, iron ore, wet concrete, triple super-phosphate, ammonium sulphate, and sticky fertilizers.

Pressure-molded neoprene or rubber discs on a flexible steel cable conform to load and cushion the belt, help keep belt aligned, and are self-cleaning. The two bearings are up out of the dirt zone; have had no design failures.

Unaffected by most corrosives that damage steel, the new idler is ideal for chemical, sulphur and salt plants; corrosive and high ozone atmospheres. It is more abrasive-resistant than steel and flexes out of the way of abrasive materials.

The Limberoller weighs ⅔ less than a conventional steel idler; is locked by a simple cotter key into special lightweight stands for easy installation and removal. No cover sheets are needed. Two types of stands are available: one that bolts to conventional rigid sections; and a self-supporting type that forms its own easily-erected portable sections without bolts, by using special stiffening rails.

Because of these unique features, many companies have adopted Limberollers as standard for all belt conveyor operations. Details from *Joy Mfg. Co., Oliver Bldg., Pittsburgh 22, Pa. Request Bulletin* 82-11.

Harry –
This is that new belt conveyor idler I was raving about the other day.
E.J.W.

"No bump" feature eliminates segregation of wet concrete thin on belts (and permits wider spacing of idlers

Triple Super Phosphate DOES NOT BUILD UP ON LIMBEROLLER ROLLS! (Builds up 2" thick, with jagged edges on steel rolls - requiring constant work by men with hammers + chisels to try and keep it down.

Excellent, too for quarries concrete batch plants; coal metal and non-metallic mines; foundries; coke plants

Available for belt widths of 18" to 72"

Swell for "hard-to-get-at" locations

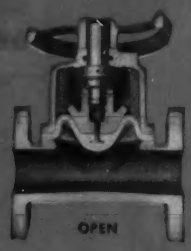
2½ years on foundry handling abrasive foundry sand with NO DOWN TIME! still going strong with little sign of wear (former idler life 3 months)

Neoprene will not support combustion is grease resistant Rubber is less expensive - better for extreme cold weather

Can even be put in or taken out while belt is moving

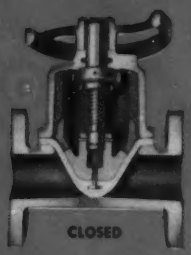
Flow Characteristics
similar to gate valves

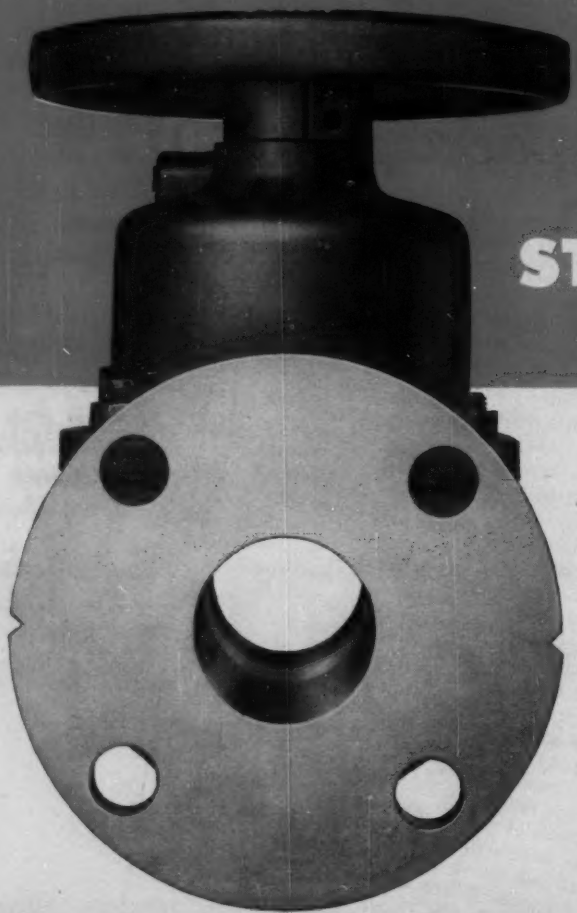
- Streamlined straight-through flow
- Minimum pressure drop
- Handles viscous materials without stoppage
- May be rodded or brushed



Advantages
of a diaphragm valve

- Positive closure even with gritty or fibrous materials
- No pockets to trap sludge
- Bonnet mechanism completely isolated from fluid in line
- Completely self-draining
- Simple maintenance





GRINNELL-SAUNDERS
STRAIGHTWAY
DIAPHRAGM VALVE

For handling viscous materials, slurries, sludges, solids in suspension, sewage and corrosive chemicals, Grinnell now offers a valve which has all the advantages of a diaphragm valve with the added benefits of straight-through flow.

The Straightway Diaphragm Valve* is made in sizes from ½" to 8", screwed or flanged ends, either hand wheel or power operated.
A variety of body, lining and diaphragm materials are available to meet practically all requirements. Descriptive folder gives all details.

*Patented

GRINNELL COMPANY, INC., PROVIDENCE, RHODE ISLAND
Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping plumbing and heating specialties • water works supplies • industrial supplies Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

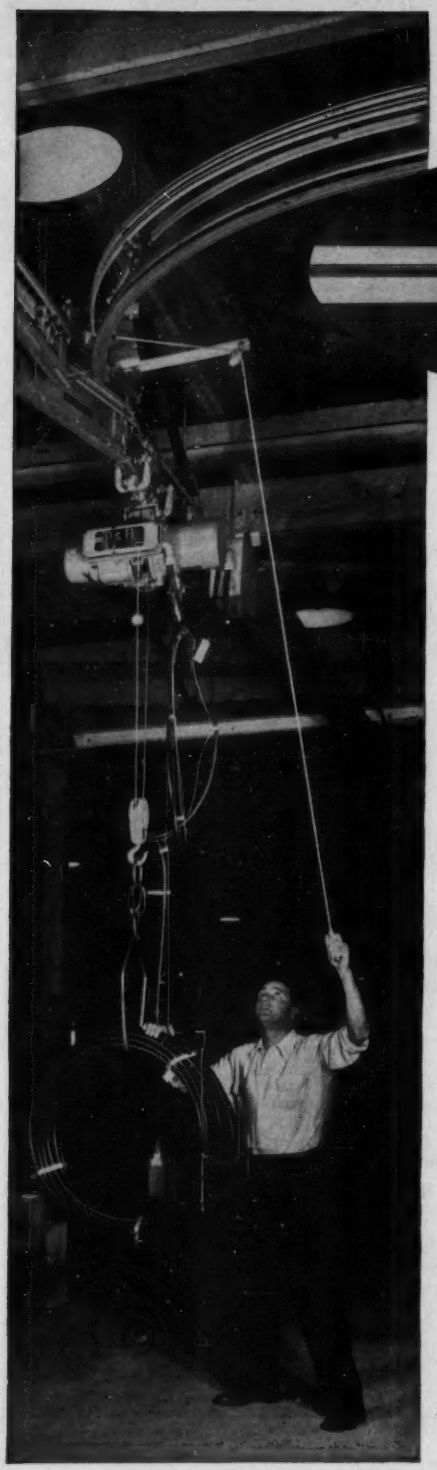
GRINNELL COMPANY, INC.
291 West Exchange St., Providence, R. I.

Kindly send me a copy of bulletin describing Grinnell-Saunders Straightway Diaphragm Valves.

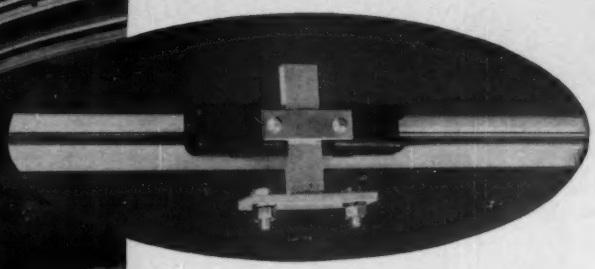
Name_____
Title_____
Company_____
Address_____
City_____ State_____

Another new development using

B. F. Goodrich Chemical *raw materials*



B. F. Goodrich Chemical Company does not manufacture this extrusion. We supply only the Geon rigid vinyl materials.



Rigid Geon packs power in small space

NAKED wires on an overhead power lift are a hazard, lose power along the line and have to be spaced widely where multiple electrical contacts are needed in large plants. As a product improvement, a manufacturer has designed U-shaped extruded insulation made of Geon rigid vinyl that has many advantages for the job.

The rigid vinyl extrusion carries a metal contact conductor safely so that as many as three to twelve power lines can be installed close together where space is tight. Because this insulation is made of Geon rigid vinyl it has high dielectric strength, high insulation resistance with low power loss. It has good chemical and abrasion resistance, necessary for long life in industrial plants and it can be colored according to local code requirements.

This installation you see here is a good example of a new use for Geon rigid vinyl. It may suggest a new use to you or may give you an idea for another saleable product. There are scores of other uses for Geon materials from rigid sheeting to rigid pipe and fittings. For technical help in the uses of versatile Geon please write Dept. DB-5, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable.

GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

There's No Other Welding Tee Like This!

FLOWLINE

TRADE MARK

STAINLESS STEEL, MONEL, NICKEL and ALUMINUM WELDING FITTINGS

Preferred for Dependable Corrosion Service

The Welding Fittings organization — recognizing the superiority of welded piping for corrosion service — was the first to standardize, manufacture, and stock a complete line of stainless steel welding fittings.

The tee shown above—typical of all FLOWLINE Welding Fittings—provides unique features that have been developed through long, intensive specialization in design and production of welding fittings for corrosion service.

FLOWLINE fittings—tees, ells, reducers, stub ends, and caps—are available in sizes ½" through 12", in Schedules 5S, 10S, 40S, and 80S.

Features of FLOWLINE Tees

- Cold formed — seamless — by the exclusive Welding Fittings process.
- Reinforced crotch—tee is stronger than pipe with which it is used.
- Full center to face dimensions.
- Smooth interior walls.
- Ends machine tool cut and finished.
- Annealed, cleaned bright, passivated.
- Heat number permanently stamped on each tee as record of actual analysis and physical properties.
- Every tee is marked with type of metal, size, schedule, wall thickness, and FLOWLINE trade mark.

WELDING FITTINGS CORP.

NEW CASTLE, PENNSYLVANIA

W-10 *World's Largest Manufacturer of Stainless Welding Fittings*

This "Baby" Bird proves what its Big Brother can do . . .

BEFORE YOU BUY YOUR FILTERING EQUIPMENT

EXAMPLE:

Removing a Process "Stumbling Block"

In working out the processing of a new synthetic resin, the dewatering step posed a serious problem until tests showed that the Bird Continuous Centrifugal Filter could meet all process requirements, as well as preventing the solids build-up or fusion previously thought unavoidable.

EXAMPLE:

Achieving an Efficient Wash *Continuously*

Before visiting the Bird Research and Development Center, one user doubted the ability of the Bird Continuous Centrifugal Filter to wash adipic acid solids as efficiently as could be done in a batch centrifugal. Test results showed that an unwashed cake containing .76% impurity, was washed in the Bird to 99.99% purity with only .55 lbs. of wash per lb. of dry solids — results equal to any ever obtained with batch equipment.

EXAMPLE:

Speeding Up Production and Lowering Solvent Losses

In the process of recovering inedible cocoa butter from expeller cake, one of the steps involves removing 5% entrained solids from an oil rich solvent. Unhappy with results being obtained, the processor had the Bird Research and Development Center make tests which showed that the Bird Continuous Centrifugal Filter could do the job at a greatly increased production rate with an appreciable reduction in solvent loss. Special vapor-tight construction of the Bird is a big advantage on applications like this.

EXAMPLE:

Making the Grade When Operating Conditions Get Tough

In a "detinning" plant, existing methods of recovering sodium stannate from a dissolving solution proved wholly inadequate when the strength of the caustic solution had to be sharply increased to handle a new type of lacquer being applied to the tinned sheet. Tests made on a sample of the dissolving tank slurry showed that a Bird Continuous Centrifugal Filter handled this tough job efficiently, recovering practically all of the tin value.

The Bird Research and Development Center has the pilot-scale facilities and equipment to prove to you exactly what you'll be getting in terms of moisture removal, tonnage, filtrate clarity, washing efficiency and cost per ton — *in advance* of your investment in equipment. Why not make use of these unsurpassed test resources whenever *you* encounter a solids-liquids separating problem?

A corner of the test floor of the Bird Research and Development Center, showing the feed tank mezzanine. Feed and filtrate up to 2500 gallons are readily handled.

BIRD

Leading Authority on Solids-Liquids Separations

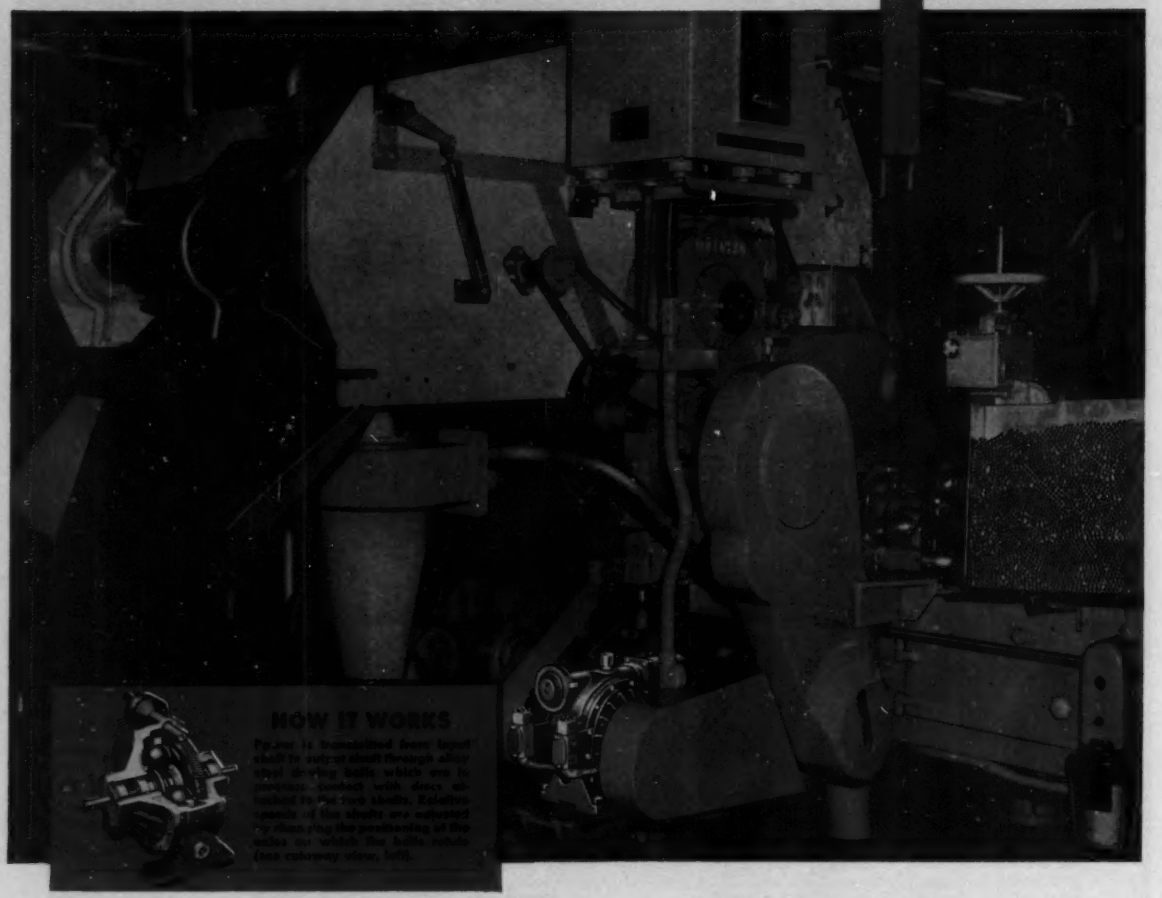
Builders of

- *Bird Continuous Centrifugal Filters*
- *Bird-Prayon Continuous, Rotary, Horizontal Vacuum Filters*
- *Bird-Young Continuous Rotary Vacuum Filters*
- *Bird Horizontal Tank, Vertical Leaf Pressure Filters*
- *Bird-Humboldt Screen Type Centrifugal Dryers*
- *Bird Suspended Centrifugals • Bird Centrifugal Classifiers*
- *Bird Continuous Centrifugal Coal Filters • Bird Polishers*
- *Bird Centrisweeps for delicate Crystals, Fibrous Materials*

For specific information on individual machines write Bird Machine Company, South Walpole, Massachusetts Regional Offices: Evanston, Illinois • Portland, Oregon

AccuRay electronic brain gets muscle power from Cleveland Speed Variator

The electronic control mechanism of this cigarette machine, known as the AccuRay cigarette gage controller, built by Industrial Nucleonics Corp., Columbus, Ohio, employs Cleveland Speed Variator size 4K4, driven at 1200 rpm input.



NATIONALLY famous for checking and controlling the making of Chesterfield cigarettes, AccuRay depends on a Cleveland Speed Variator for the delicate job of adjusting the tobacco feed rate in response to impulses from the gaging mechanism.

Being infinitely variable, the Cleveland Speed Variator gives stepless speeds over a full 9:1 range—from ⅓ to 3 times input speed. Output speed on this application is adjusted automatically by a regulating motor mounted on the Variator—but could be regulated manually or by remote controls of other types.

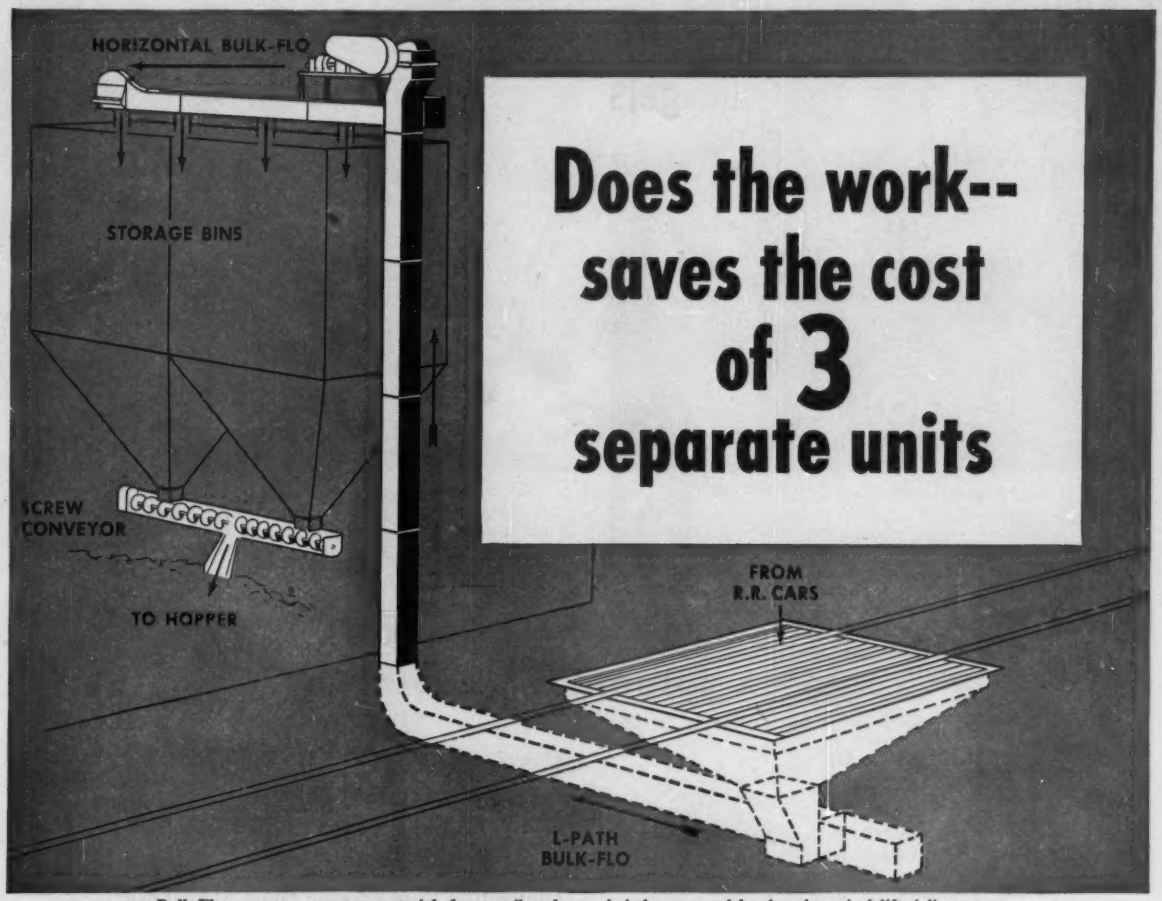
Available in eighteen standard types and sizes, the Cleveland Speed Variator offers these major advantages: 1. An extremely compact unit with input and output shafts in line and rotating in the same direction; 2. Almost any input speed up to 1800 rpm can be used—either clockwise or counterclockwise rotation; 3. Rated for constant horsepower output over a 9:1 range, or for constant output torque with a 6:1 range; 4. Infinitely variable over the entire speed range; 5. Rapid response to speed change, precise adjustment, and accurate maintenance of speed settings; 6. Long life and minimum maintenance due to absence of belts or complicated linkages; 7. Ample bearing support for overhung pulleys on either input or output shafts.

Write for Bulletin K-200 for detailed description with photographs, sectional drawings, rating tables and specifications.

THE CLEVELAND WORM AND GEAR COMPANY

Speed Variator Division, 3275 East 80th Street, Cleveland 4, Ohio

Sales Representatives in all major industrial markets • In Canada—Peacock Brothers Limited



Does the work-- saves the cost of 3 separate units

Bulk-Flo conveyors carry material from railroad cars to storage bins. Horizontal run of L-path unit is below ground level and vertical lift delivers to a horizontal Bulk-Flo on the roof.

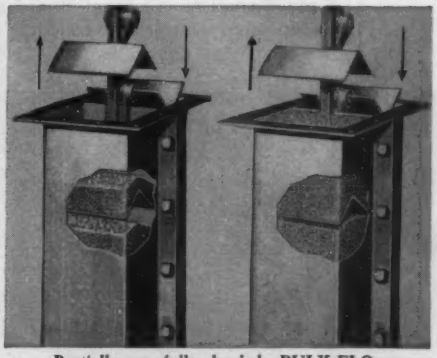
LINK-BELT BULK-FLO

feeds • conveys • elevates

HERE's a single, compact conveying medium that combines three vital functions. It's the Link-Belt self-feeding Bulk-Flo that moves a wide variety of materials horizontally, vertically, on an incline, or combinations of all three.

Granular, crushed, ground or pulverized materials of a non-abrasive, non-corrosive nature are handled gently in individual self-clearing compartments. Even friable materials are safely conveyed . . . with a minimum of breakage, degradation, dusting or contamination. Two basic styles are available—one for lumpy materials, the other for free-flowing materials.

There's a wide range of designs that can be engineered to match your system requirements. For complete information ask your Link-Belt office for your copy of 28-page Data Book 2475.

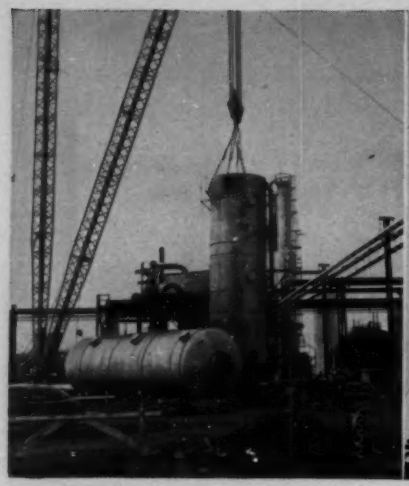


Partially or fully loaded, BULK-FLO provides positive, gentle movement of material. Unlike conventional designs, BULK-FLO's capacity can be varied by regulating feed to meet demand changes.

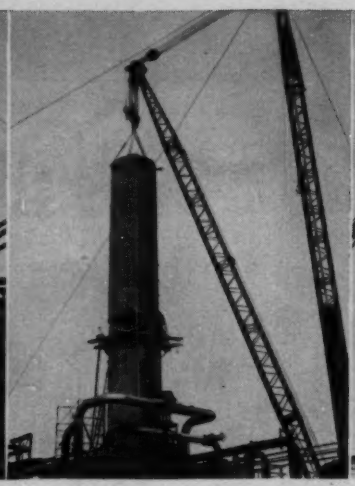
LINK-BELT

BULK-FLO FEEDERS • CONVEYORS • ELEVATORS 14,804

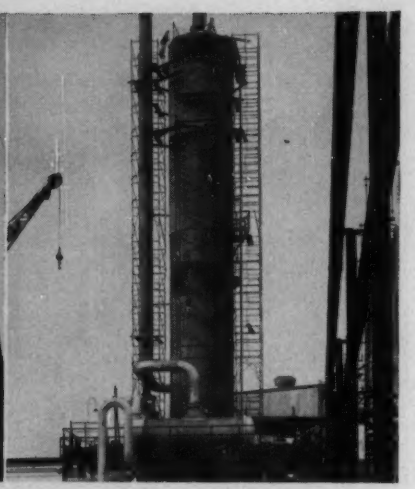
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



Stainless steel column was shipped to the site in two pieces. Carbon steel skirt and base also shipped in halves, field welded under Downingtown supervision.



Lining up for girth weld. Match marked sections welded in the field under supervision of Downingtown Iron Works personnel.



Completed column tested by Downingtown ...inspected by customer and by Hartford ...Code stamped on location. Ready for insulation when this shot was made.

More than 86,680 stainless steel welds in complex column by Downingtown

Diameter: 11′ 11″ I.D.

Total Height: 93′ 11″.

Material: Stainless steel, Type 304. Carbon steel skirt and base ring.

Shell Thickness: ½″ and ⅜″.

40 Trays and downcomers. 177 bubble caps and risers on each tray.

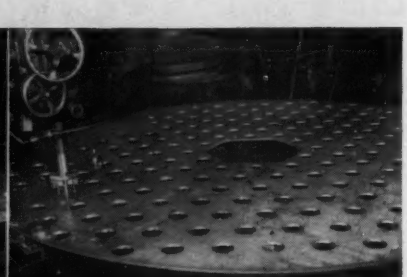
Code Stamping: National Board and ASME. Sandblasted and pickle washed.

Downingtown welders completed more than 86,680 separate stainless steel welds during fabrication of this stainless steel column. Tolerances of ±⅛″... ±1/16″... even ±1/32″... were maintained in the shaping, positioning and welding of thousands of stainless steel parts. Lapsed time from drawing board to final field testing: less than six months.

Send for Bulletin PF. It tells the story of Downingtown skill and experience that enable us to breeze through complex fabrication jobs like this one.

Column section showing bubble tray in place. Skillful welding was required to hold extreme tolerances on flatness of trays... level of weirs...placing of 7080 bubble caps.

Special jig for welding stainless steel risers to stainless steel tray. 177 risers and bubble caps per tray. 40 trays and downcomers. Note manhole in center.



Drilling riser holes in tray. The 40 trays, ½″ thick, were solid stainless steel. Trays were positioned in column with leveling lugs and pins, then welded to shell and downcomer.

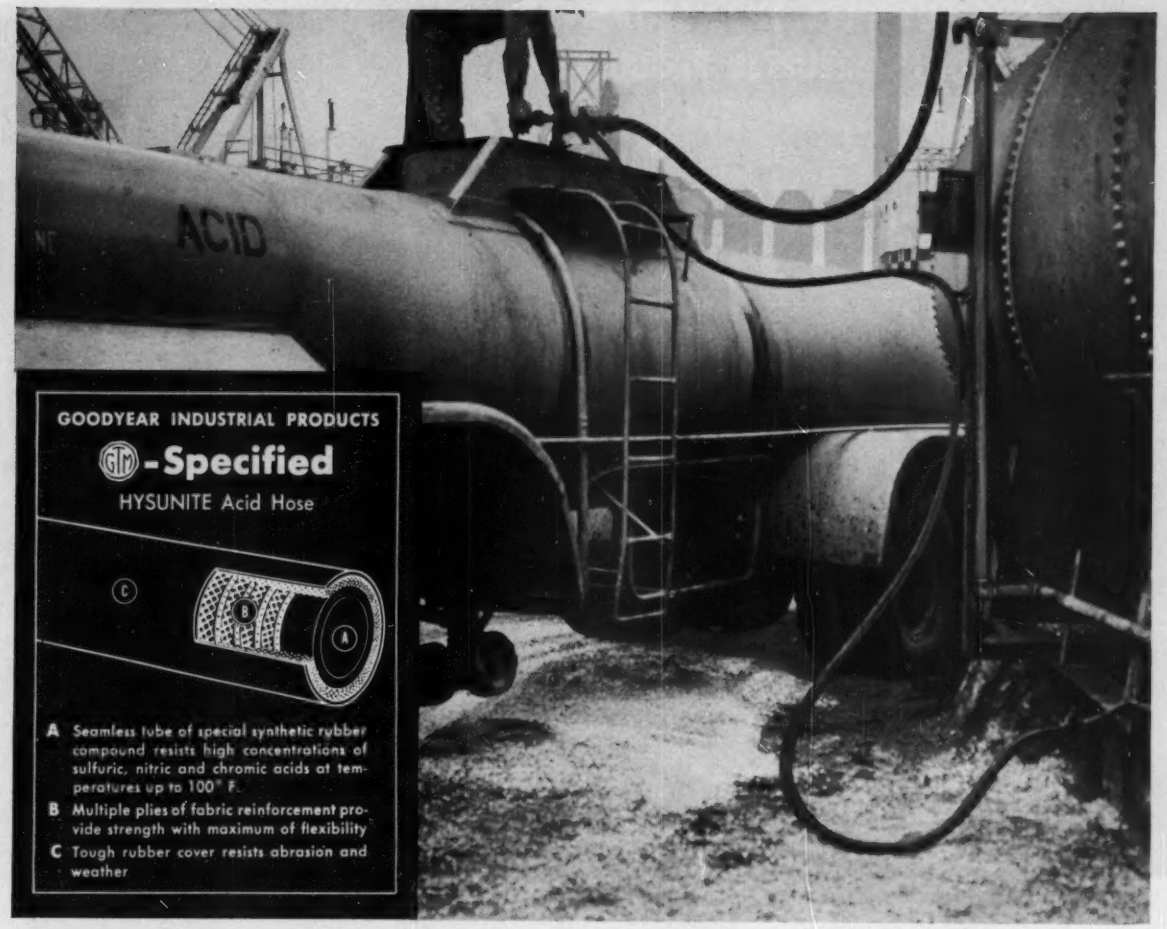
Downingtown Iron Works, Inc.

HEAT EXCHANGERS—STEEL AND ALLOY PLATE FABRICATION

140 Wallace Ave., Downingtown, Pennsylvania—Branch Offices:

52 Vanderbilt Ave., Rm. 2025, New York 17 • 203 Hanna Bldg., Cleveland 15, Ohio • 936 W. Peachtree St., N.W., Rm. 113, Atlanta 3 • 208 S. LaSalle St., Rm. 792, Chicago 4
533 Roosevelt Bldg., Los Angeles 17 • 4550 Main St., Rm. 206, Kansas City 6, Mo. • Division of Pressed Steel Tank Company, 1447 S. 66th St., Milwaukee 14, Wis.

CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS


ACID
GOODYEAR INDUSTRIAL PRODUCTS
G.T.M.-Specified
HYSUNITE Acid Hose
C
B
A
A Seamless tube of special synthetic rubber compound resists high concentrations of sulfuric, nitric and chromic acids at temperatures up to 100° F.
B Multiple plies of fabric reinforcement provide strength with maximum of flexibility
C Tough rubber cover resists abrasion and weather

G.T.M. increases acid hose life by 900%

ACID–66° Baume Sulfuric–was the problem at this eastern steel mill. Many types of hose were tried for its transfer from truck to storage tank. But the best hose delivered *only 2,500,000 lbs.* of acid, before embrittling and breaking.

Then the G.T.M.–Goodyear Technical Man–recommended his new HYSUNITE Hose, specifically developed to handle highly oxidizing acids in high concentrations at temperatures up to 100° F. This rugged hose handled a fabulous *26,500,000 lbs.* of acid–was good for many more pounds – when it was removed from service for thorough checking.

If you have hose problems, it will pay you to consult your Goodyear Distributor and/or the G.T.M. Or write Goodyear, Industrial Products Division, Akron 16, Ohio.

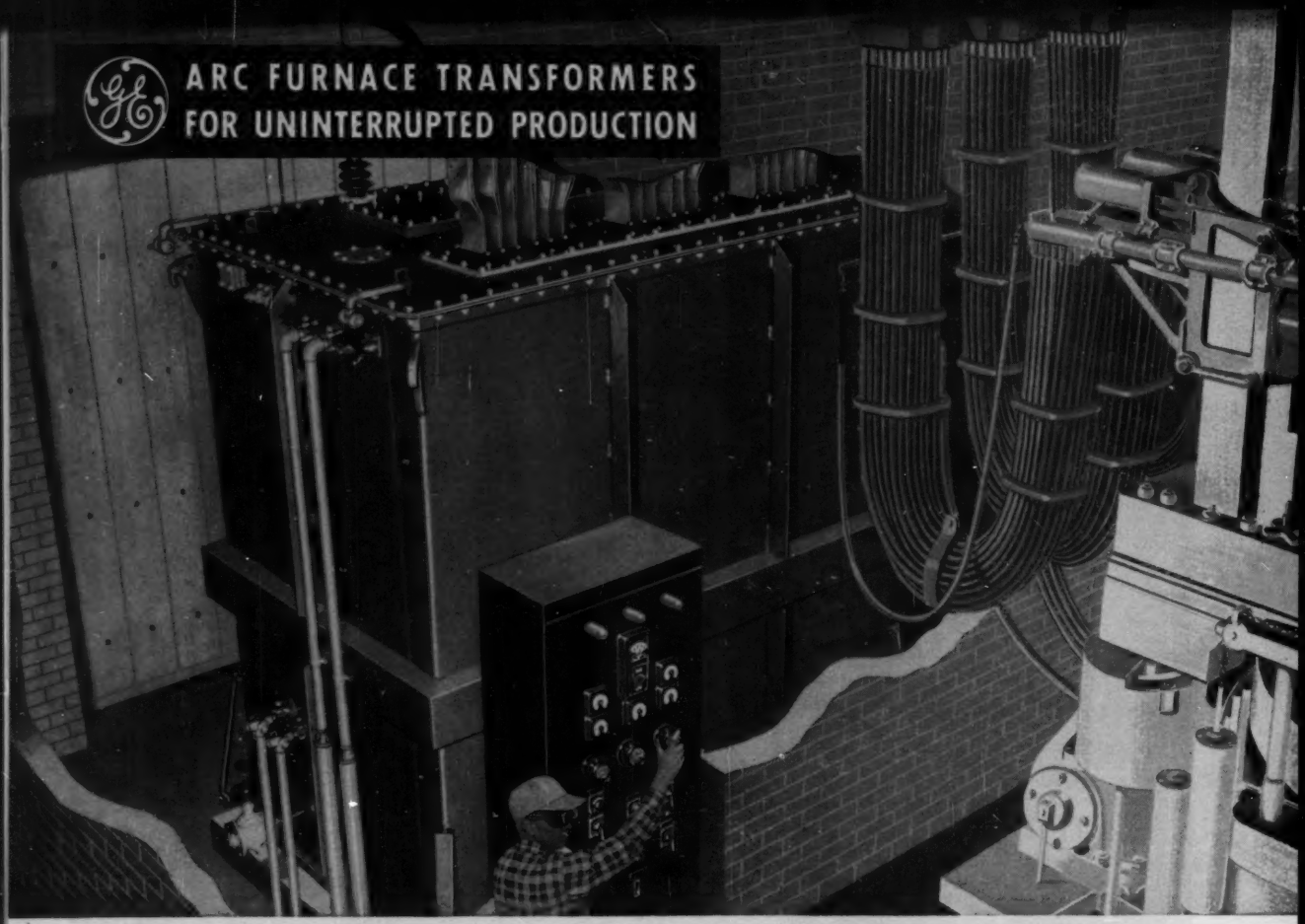
HYSUNITE HOSE by

Hysunite–T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

GOODYEAR

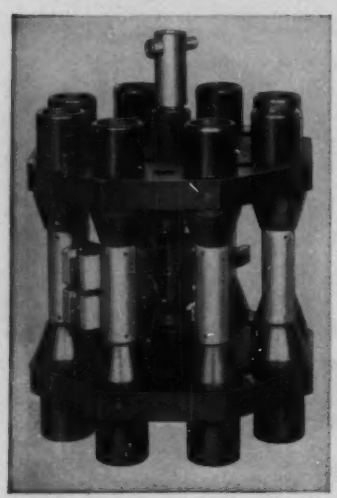
THE GREATEST NAME IN RUBBER

IT'S SMART TO DO BUSINESS *with your Goodyear Distributor. He can give you fast, dependable service on Hose, V-Belts, Flat Belts and many other industrial rubber and nonrubber supplies. Look for him in the Yellow Pages under "Rubber Goods" or "Rubber Products."*



YOU CAN COUNT ON PRODUCTION CONTINUITY WHEN YOU INSTALL A GENERAL ELECTRIC ARC FURNACE TRANSFORMER.

Not one G-E tap-changer contact failure since wedge-type introduction in 1938



HEART OF TAP-CHANGER mechanism is the circular arrangement of contacts. Made of specially tin-plated copper, they have high current-carrying ability with low contact temperature, and a wedging action which assures good contact under all operating conditions.

Since the introduction 18 years ago of the General Electric wedge-type tap changer, no contacts have ever separated, carbonized, welded, or otherwise failed according to our records. This is another example of the outstanding record of reliability established by G-E arc-furnace transformers.

The tap changer itself is designed with liberal electrical, mechanical, and thermal safety factors. It can, in fact, withstand the full short-circuit current of the transformer without injury. Furthermore, a special safety interlock between tap-changer driving mechanism and primary circuit breaker prevents any chance of tap-changer operation under load. Because of the tap changer's reliability, it can be strategically located in the main tank close to the windings, thus permitting great savings in floor area.

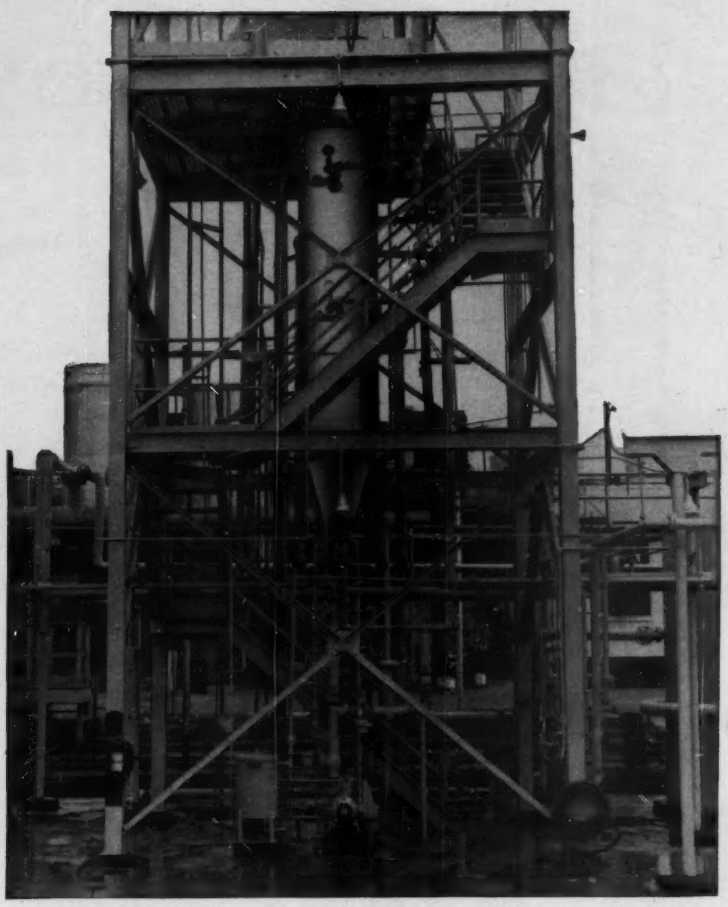
Tap changers are only one of many features which make G-E arc furnace transformers your best bet for long-term reliability. Others include core-type construction with inherently strong circular-concentric windings, dust-tight bus-bar seal, and high-pressure-tested cooling systems.

For complete details contact your nearest G-E apparatus Sales Office or write for Bulletin GEA-6236 to General Electric Company, Section 422–27, Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

SHELL OIL COMPANY solves scaling problem with Turba-Film Evaporator



Turba-Film Evaporator used by Shell Oil Company, Martinez, California, dries a special type of oil, eliminates scale formation on heat transfer surfaces and provides continuous operation. The Turba-Film Evaporator shown is a No. 5 model built to Shell's specifications with stainless steel rotor, vapor section and outlet cone. It processes 30 barrels of oil per hour.

The problem:

to reduce moisture content of a special type of oil from an initial content of 3 to 6% to a maximum of 0.2%. Standard stills achieved the specified moisture content but deposited inorganic salts as scale on the heat transfer surfaces in such quantities as to demand frequent shutdown for cleaning.

The solution:

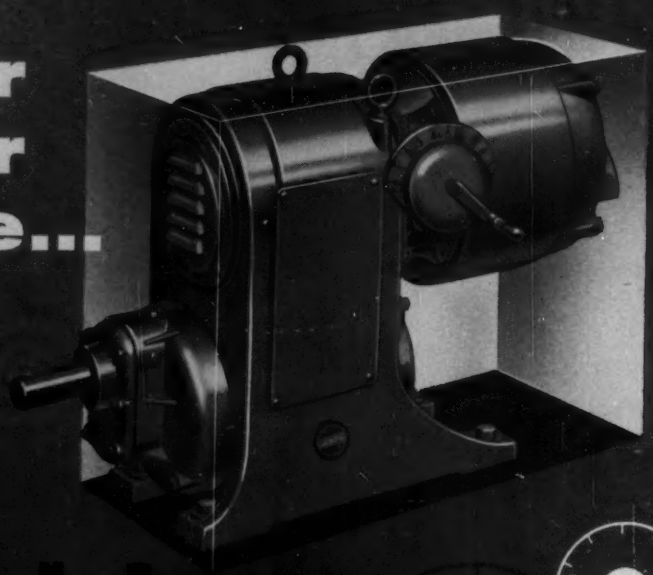
the Turba-Film® Evaporator, now in use for over a year, reduces 30 barrels of oil per hour to the specified moisture content – usually even lower – and precipitates the scale-forming substances in the dried oil, from which they are easily filtered. Shell now enjoys continuous operation in this process without shutdown for cleaning.

The patented Turba-Film Evaporator and the Rodney Hunt-Luwa Spray Dryer have a broad range of moisture-removal application in the Chemical Process Industries. Send for informative literature on Rodney Hunt process equipment.

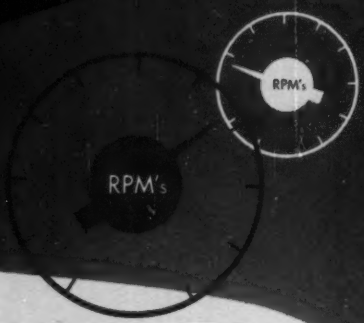
RODNEY HUNT MACHINE CO.
Process Equipment Division
31 Vale Street, Orange, Massachusetts, U. S. A.

RODNEY HUNT®

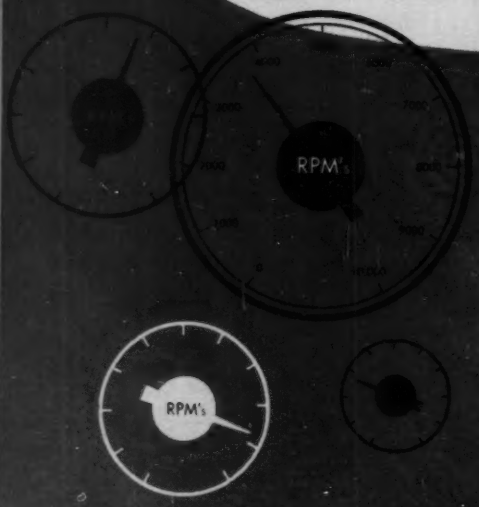
The Popular Power Package...



for Variable Speeds...



U.S. Varidrive



This popular unit combines an induction motor, variable speed drive, and gearing to give a complete variable speed power source. Often used to replace constant speed motors, it is easily installed and occupies minimum space. Rugged industrial construction gives long life even when operated under severe conditions. It requires no extraneous electronic equipment or bulky power conversion devices. Varidrives are popular with equipment manufacturers because they increase versatility and saleability of their products. Available from ¼ to 60 h.p., speed ranges cover 2 to 10,000 rpm.

U.S. Electrical MOTORS

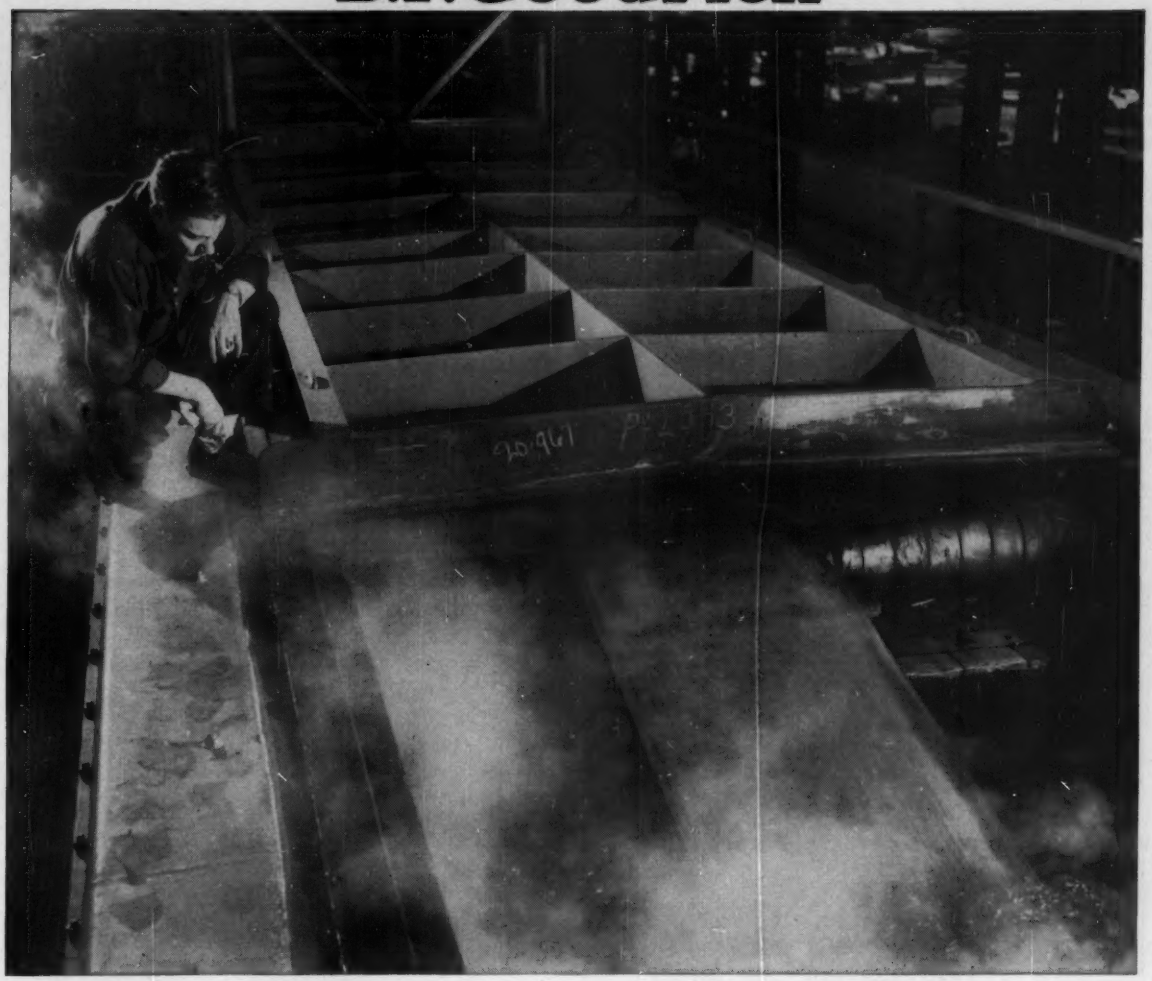
U.S. ELECTRICAL MOTORS Inc.
P.O. Box 2058, Los Angeles 54, Calif., or Milford, Conn.
☐ Send Varidrive Bulletin No. F-1797.

Name_____
Company_____
Address_____
City_____ Zone___ State_____

US MOTORS

MAIL COUPON NOW

RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER



Hot acid scrubs tomorrow's refrigerator

A typical example of B. F. Goodrich improvement in rubber

THAT sheet of steel will soon be a refrigerator—*gleaming white* because of the steaming hot acid bath.

To clean rust off steel so enamel will stick, miles of sheets are run through tanks of hot acid that eats off the film of rust. B. F. Goodrich made this low-cost method practical by developing a rubber and brick tank lining that stands the hot acid and the slicing, banging of fast-moving steel.

The sheets used to move over stationary skid blocks but these soon wore out with rubbing plus heat plus acid. Now B. F. Goodrich makes a series of small rubber rolls that really turn and the one remaining reason for frequent shutdown has been cured. What's more, the new B. F. Goodrich segment rolls cost one-third less than the old-fashioned type, yet last 3 times longer.

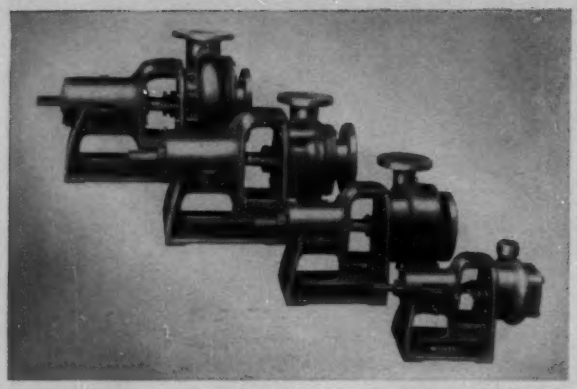
B. F. Goodrich specializes in rubber equipment to handle acids and other corrosive chemicals. Today you'll find B. F. Goodrich rubber covered rolls and rubber lined tanks, pipes and valves in the most modern plants. More important, you'll find rubber lining in some places where it has lasted 15 and even 20 years.

When you buy B. F. Goodrich lining you buy years of engineering background with it—experience that makes sure your lining will be exactly fitted to meet all the special requirements of your work. You buy something else, too—assurance of satisfactory performance that can come only with a product that has proved itself by years of success in actual use. *The B. F. Goodrich Company, Dept. M-638, Akron 18, Ohio.*

B.F. Goodrich
INDUSTRIAL PRODUCTS DIVISION

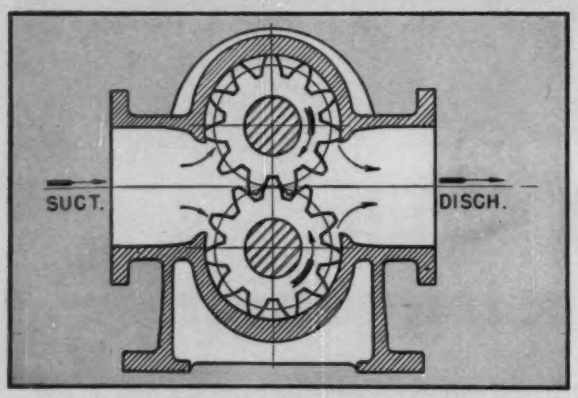
WHAT'S YOUR P.Q.*?

* Pump Quotient



Why are more and more end-suction pumps being specified? The answer's *simplification.* Industry is turning to end-suction pumps because they simplify piping (especially in process applications), need only one stuffing box, and make parts replacement easy. Get the full story on the Worthington end-suction pumps by writing to Section PC.4.8.

What is Worthite? Worthite is Worthington's "super-stainless", corrosion-resisting alloy steel containing more than 50% of the alloying elements: nickel, chromium, molybdenum, silicon, copper and manganese. The balance is mainly iron. Worthite was first introduced in 1936 and has gained wide acceptance as an excellent construction material for applications where corrosion is a problem. Worthington, of course, offers a complete line of Worthite pumps. Write for Bulletin W-350-B4.



Why are gear-type rotary pumps best for handling high-viscosity fluids? Lots of reasons. First, their large, unobstructed passages mean low entrance losses. Then, there aren't any valves or valve springs. Also, there's the flexibility in application offered by the wide speed range of gear-type rotaries. Write for Bulletin W-483-B2 for facts about the Worthington double-herringbone gear rotary pumps and vane pumps. PC.4.8

See your Worthington distributor for more information about end-suction pumps, Worthite and gear-type rotary pumps. But if you want to read up on these products before talking to him, write for our bulletins today. Worthington Corporation, Merchandising Division, Section PC.4.8, Harrison, New Jersey.

WORTHINGTON

BUY THESE WORTHINGTON STANDARD PRODUCTS FROM YOUR LOCAL DISTRIBUTOR

Air Compressors • Pumps • Multi-V-Drives • Allspeed Drives

C & I on stream at SOHIO

180 ton-per-day Nitric Acid Plant designed and built by C & I for Sohio at Lima, Ohio.

This plant is one of many large capacity, single unit plants recently completed by C & I. They operate in excess of 345 days a year with excellent overall efficiency and minimum production costs. If you are considering nitric acid facilities it will pay you to consult C & I.

250 ton-per-day Ammonium Nitrate Solutions Plant designed and built by C&I for Sohio at Lima.

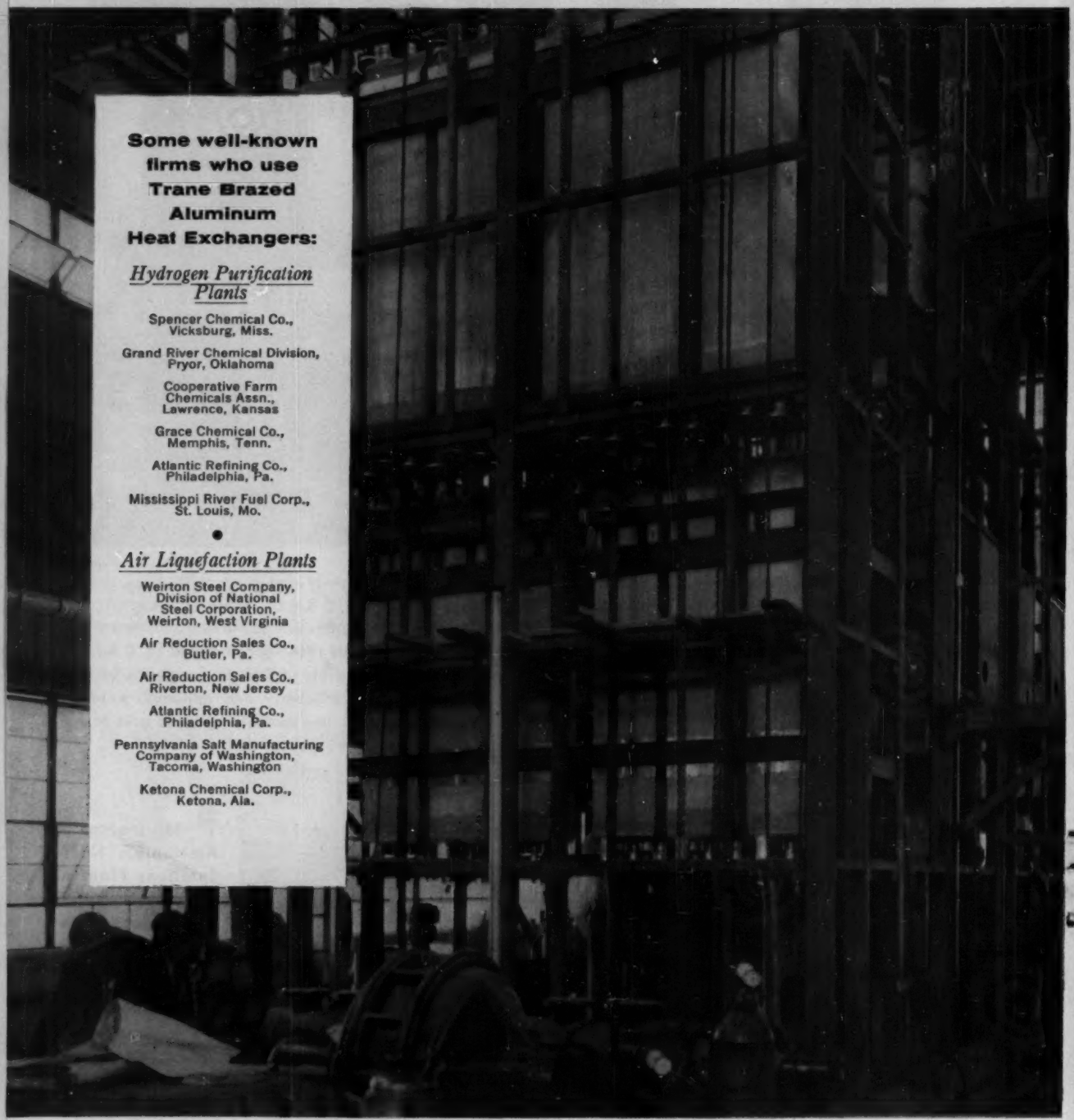
Write C & I for complete information on the new Spherical Form Ammonium Nitrate produced by the CSC Stengel Process, now available through C & I.

THE CHEMICAL AND INDUSTRIAL CORP.

CINCINNATI 26, OHIO

Designers and builders of the world's best plants for Nitric Acid • Phosphoric Acid • Ammonium Nitrate • Complex Fertilizer • Ammonium Phosphate

We have designed Brazed Aluminum



Some well-known firms who use Trane Brazed Aluminum Heat Exchangers:

Hydrogen Purification Plants

Spencer Chemical Co., Vicksburg, Miss.

Grand River Chemical Division, Pryor, Oklahoma

Cooperative Farm Chemicals Assn., Lawrence, Kansas

Grace Chemical Co., Memphis, Tenn.

Atlantic Refining Co., Philadelphia, Pa.

Mississippi River Fuel Corp., St. Louis, Mo.

●

Air Liquefaction Plants

Weirton Steel Company, Division of National Steel Corporation, Weirton, West Virginia

Air Reduction Sales Co., Butler, Pa.

Air Reduction Sales Co., Riverton, New Jersey

Atlantic Refining Co., Philadelphia, Pa.

Pennsylvania Salt Manufacturing Company of Washington, Tacoma, Washington

Ketona Chemical Corp., Ketona, Ala.

The cold box at Air Reduction's Butler, Pa. plant consists of 18 TRANE Brazed Aluminum cores in six parallel columns. Each core contains 7,000 sq. ft. of heat exchange surface, weighs less than 1,000 lbs. Air at approximately 80 psig and nitrogen streams are reversed on a 10-minute cycle to clean up condensed water, ice, CO_2 and other impurities deposited in air passages. More and more air separation and ammonia plants are turning to TRANE Brazed Aluminum Heat Exchangers for efficient heat transfer.

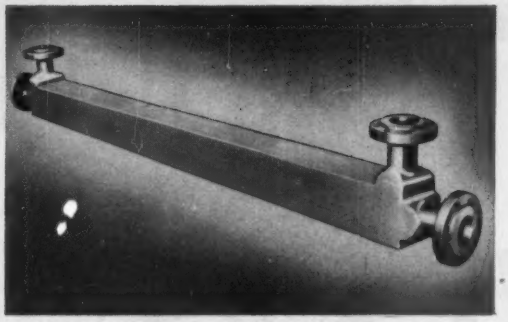
plants around Trane Heat Exchangers...

Says Air Reduction Company

"Our Butler plant, using TRANE Brazed Aluminum Heat Exchangers, went into operation in 1952. We are now increasing the capacity of this plant, enlarging our Riverton, N.J. plant and building a new plant in Chicago. These operations are designed around TRANE Brazed Aluminum Heat Exchangers. Here at Air Reduction Company it is essential that our product be *clean*—and that we get good, efficient, economical heat exchange."

Like Air Reduction Company, today's most modern air separation and ammonia plants rely on efficient TRANE Brazed Aluminum Heat Exchangers for cutting costs, maintaining highest production standards.

If you have a heat transfer problem that involves low temperatures, multi-stream exchange or close approaches, turn to TRANE! Thirty years of varied heat transfer experience is at your service. For more information, just contact your nearest TRANE Sales Office, or write TRANE, La Crosse, Wis.



TRANE Heat Exchanger for two-stream, higher-pressure applications. Can be used for industrial and process applications requiring operating pressures up to 600 psig.

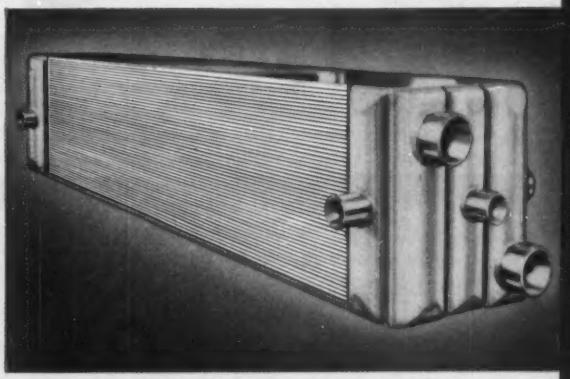
For heating, cooling, ventilating...
For <u>any</u> air condition, turn to

TRANE

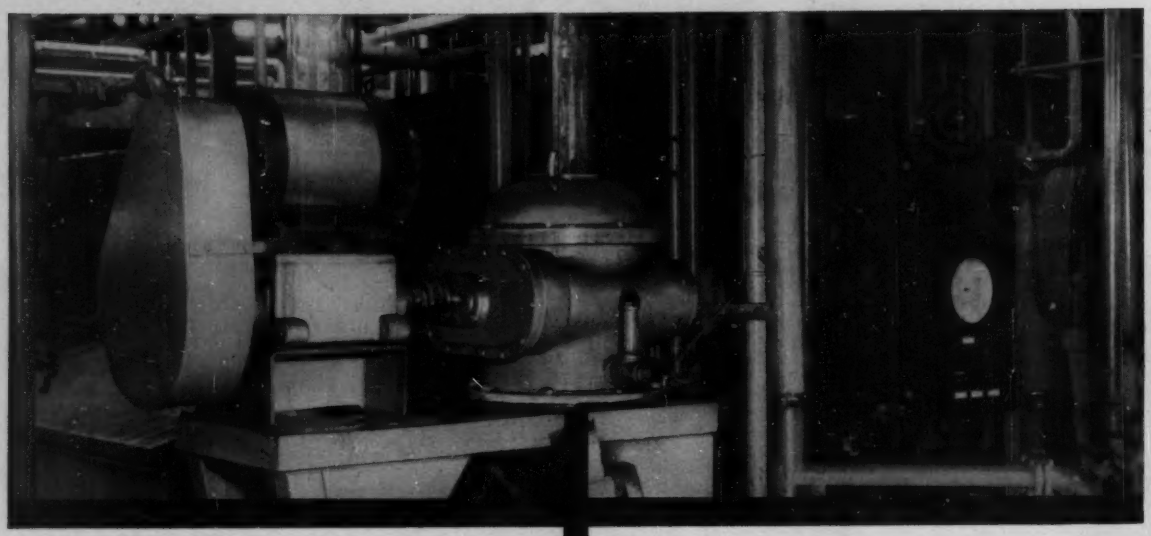
MANUFACTURING ENGINEERS

THE TRANE COMPANY, LA CROSSE, WIS. • EASTERN MFG. DIV., SCRANTON, PA.
TRANE COMPANY OF CANADA, LTD., TORONTO • 90 U.S. AND 19 CANADIAN OFFICES

For liquid-to-gas applications, fins and passages are specially constructed to handle gas and liquids. If you have a heat transfer problem involving low temperatures or close approaches, turn to TRANE for the right equipment!



Headered for 5-stream operation, this TRANE Brazed Aluminum Heat Exchanger can handle as many as five fluids simultaneously. Units are available for either cross-flow or counter-flow operation.



Take this Nettco Model T-27 Drive, for example. It is an engineered combination of Nettco experience and Nettco equipment—and because it's RIGHT for the job, this agitator speeds processing, reduces operating and power costs, and minimizes maintenance.

Nettco Model T Drives explain, in part, why Nettco can supply the right agitator for every job. There are five basic Model T Drives, supplied in any one of 35 easily changed ratios. This flexibility of equipment, coupled with Nettco's agitation research and experience in over 50 years of serving the process industries, is your continuing guarantee of the best in agitation from Nettco.

Bulletin No. 551, describes Nettco tank top, side entering, and pipe line mixers and Nettco agitator accessories.

Bulletin No. 532, a detailed review of the Nettco line of side-entering mixers for storage tank mixing.

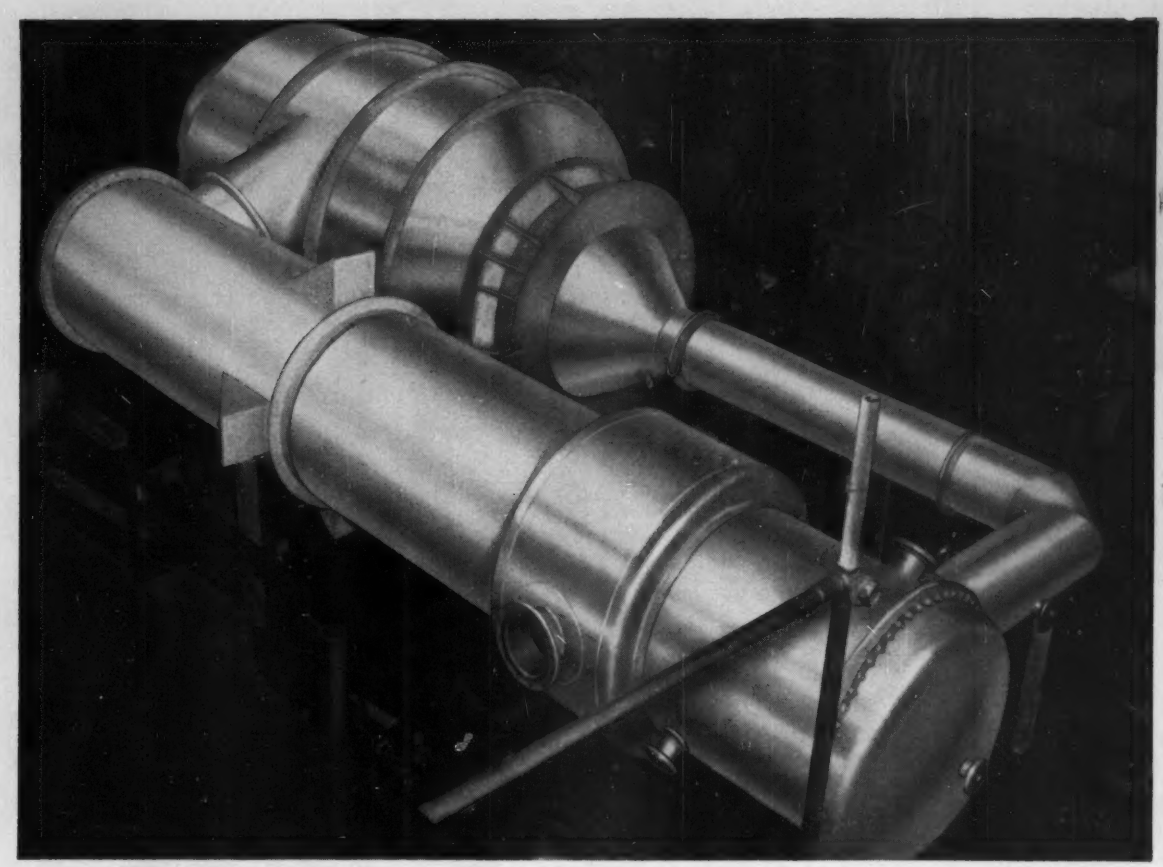
Bulletin No. 531, describes the Nettco Flomix®—a patented and unique pipe line mixer for continuous processing applications.

FOR EVERY JOB THERE'S ONLY ONE AGITATOR THAT'S

RIGHT!

May we help you get the right agitator for your job? Send for catalogs or engineered recommendations, to New England Tank & Tower Company, 87 Tileston Street, Everett 49, Mass.

NETTCO
ENGINEERED AGITATION



Why STAINLESS STEEL is best for processing Glacial Acetic Acid

This special type calandria evaporator processes glacial acetic acid. Yet its vital parts—tubes . . . liquid and vapor heads . . . downleg and centrifugal separator—are almost indestructible in this service. That's because they're fabricated of Crucible stainless steel, type 316.

The fabricator, Badger Manufacturing Company, chose type 316 stainless because it is one of the best known alloys for handling acetic acid. It is completely resistant to acetic acid in all concentrations, and under the majority of pressure and temperature conditions. And, most important, stainless steel does not contaminate glacial acetic acid.

Its *physical* properties make stainless a wise choice, too. Its high tensile strength means minimum structural support. Its practical workability permits forming complex sections without undue trouble. And these sections are readily welded, since type 316 is designed to inhibit the precipitation of harmful carbides on cooling from high temperatures.

If you're concerned with the manufacture or use of chemical processing equipment, check the advantages offered by the 30 available types of Crucible stainless steel. Your nearby Crucible representative will be glad to give you more details. Or, for an over-all look at the many uses of stainless, write for "Making the Most of Stainless Steels in the Chemical Processing Industry." *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

ROTARY VALVE DRIVES

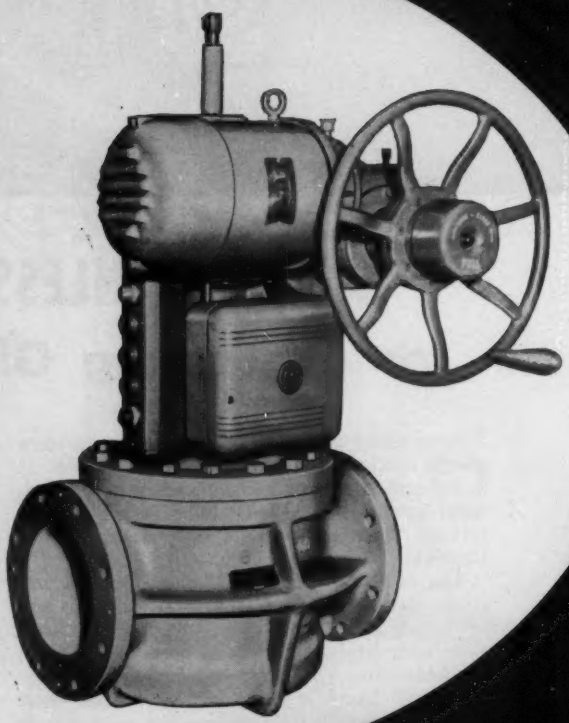
by

Janette

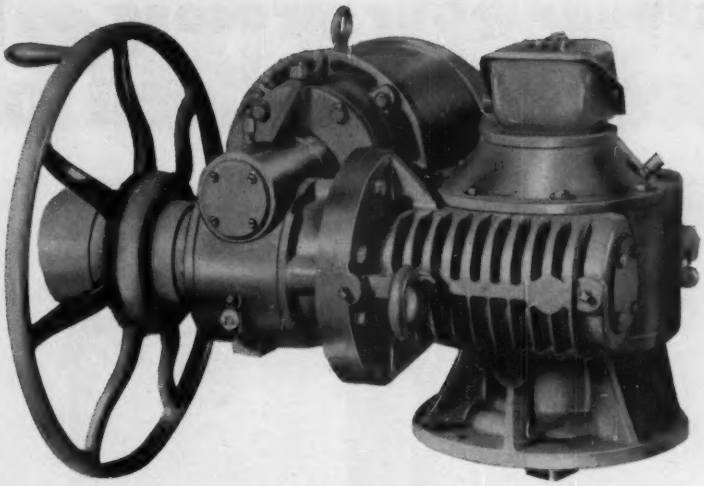
"ALL IN ONE – BUILT BY ONE"

Incorporating all of the time tested engineering principles of Janette power drives, an advanced line of Rotary Type Valve Drives is presented to meet the needs of oil, gas, chemical, water, sewage, and other types of installations.

Janette Rotary Type Drives are of the same general design and construction as those used extensively in Atomic Energy Plants, where performance and durability are vital. Built as a single unit, housings are sturdy, compact and weather-proof. Twelve assembly positions are available, with standard gear ratios of one and two R.P.M., and one thousand other options to meet special requirements.



Janette



JANETTE VALVE DRIVES
1/20 H.P. up to 3 H.P.

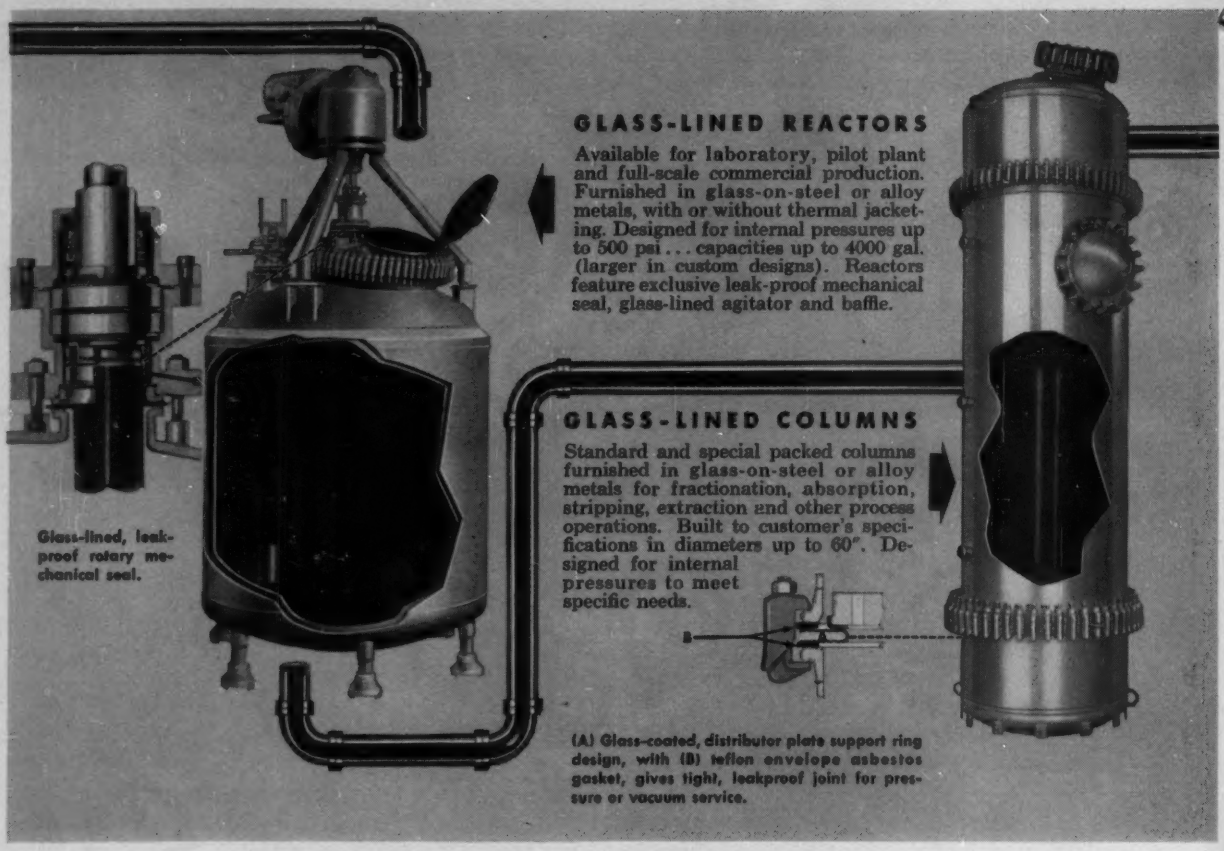
A BRILLIANT ENGINEERING ACHIEVEMENT BY AMERICA'S BEST KNOWN MANUFACTURERS OF POWER DRIVES FOR INDUSTRY

Write for new illustrated brochure, with catalog pages giving complete specifications of eight available models. Of special interest to designers and engineers. Your letterhead is all that is required.

Electric Mfg. Co.

MORTON GROVE, ILLINOIS

Whatever your process . . . insist on Glascote glass-lined products



Glass-lined, leak-proof rotary mechanical seal.

GLASS-LINED REACTORS

Available for laboratory, pilot plant and full-scale commercial production. Furnished in glass-on-steel or alloy metals, with or without thermal jacketing. Designed for internal pressures up to 500 psi . . . capacities up to 4000 gal. (larger in custom designs). Reactors feature exclusive leak-proof mechanical seal, glass-lined agitator and baffle.

GLASS-LINED COLUMNS

Standard and special packed columns furnished in glass-on-steel or alloy metals for fractionation, absorption, stripping, extraction and other process operations. Built to customer's specifications in diameters up to 60". Designed for internal pressures to meet specific needs.

(A) Glass-coated, distributor plate support ring design, with (B) teflon envelope asbestos gasket, gives tight, leakproof joint for pressure or vacuum service.

Glass-lining gives the ultimate in corrosion-resistance . . . zero contamination . . . lower cost through longer service life

YOU can use Glascote glass-lined equipment — from start to finish — for processing a variety of corrosive materials. Glascote's glass-linings put an end to contamination.

Whatever your processing system, you, too, will find it profitable to use Glascote's glass-lined equipment — pipe and fittings, reactors, columns, storage tanks, rotary dryer-blenders, etc. All designed for dependability, durability, flexibility of application and economy of operation.

What's more, you can be sure of product purity, because Glascote's chemical-resistant, acid-alkali glass offers greater resistance to corrosive action . . . greater versatility for processing products. And Glascote also offers you non-stick glass which is ideal for polymer production of all types.

Remember, for efficient heat transfer and extra-long service life insist on Glascote glass-lined products.

Ask the representative who calls on you for all the facts about Glascote products—reactors, storage tanks, columns, conical rotary dryer-blenders, receivers, condensers and accessory products. Or, if you prefer, write direct. Glascote Products, Inc., Cleveland 17, a subsidiary of A. O. Smith Corporation.

Our standard one year guarantee continues to apply to all Glascote glass-lined products.

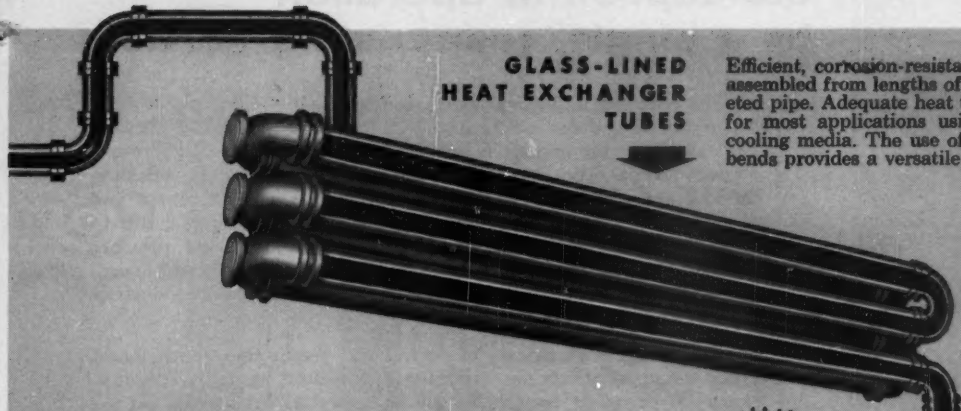
Glascote®

PRODUCTS, INC.

CLEVELAND 17, OHIO

Sales offices or agents located in New York • Philadelphia • Union, N. J. • Chicago • Cleveland • Dayton • Houston • Los Angeles
Export Sales: A. O. Smith Corp., International Div., Milwaukee 1, Wis.

from START to FINISH



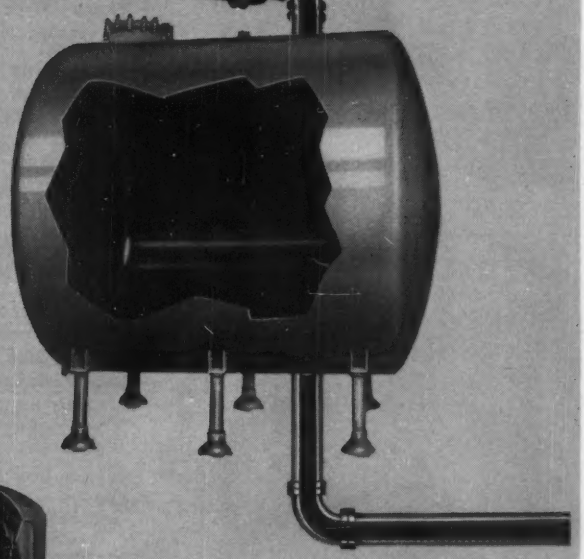
GLASS-LINED HEAT EXCHANGER TUBES

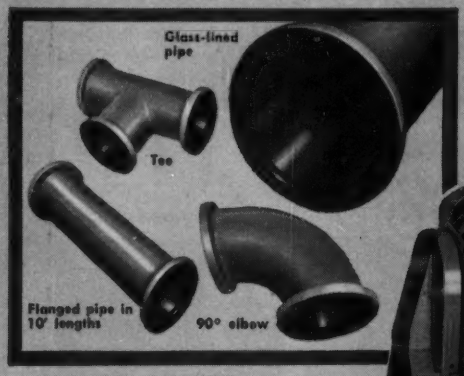
Efficient, corrosion-resistant Heat Exchangers are assembled from lengths of standard diameter jacketed pipe. Adequate heat transfer area is available for most applications using various heating and cooling media. The use of either elbows or return bends provides a versatile operating assembly.

GLASS-LINED STORAGE TANKS

Single shell glass-lined *horizontal* furnished in standard units in capacities up to 6000 gal. (larger on special order).

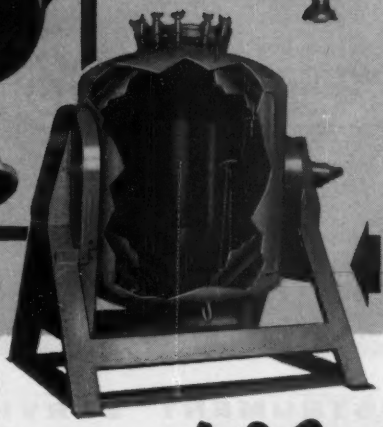
Vertical glass-lined units furnished in four standard structural types—plain and jacketed, open and closed. Standard tanks built in capacities up to 6000 gal. (larger on special order).





GLASS-LINED PIPE AND FITTINGS

Glascote produces and stocks glass-lined pipe in 10' lengths and fittings to ASME standards, in inside diameters from 1½" to 4". Six and 8", and larger sizes are fabricated to order. Leakproof gaskets available to suit material conveyed in pipe.

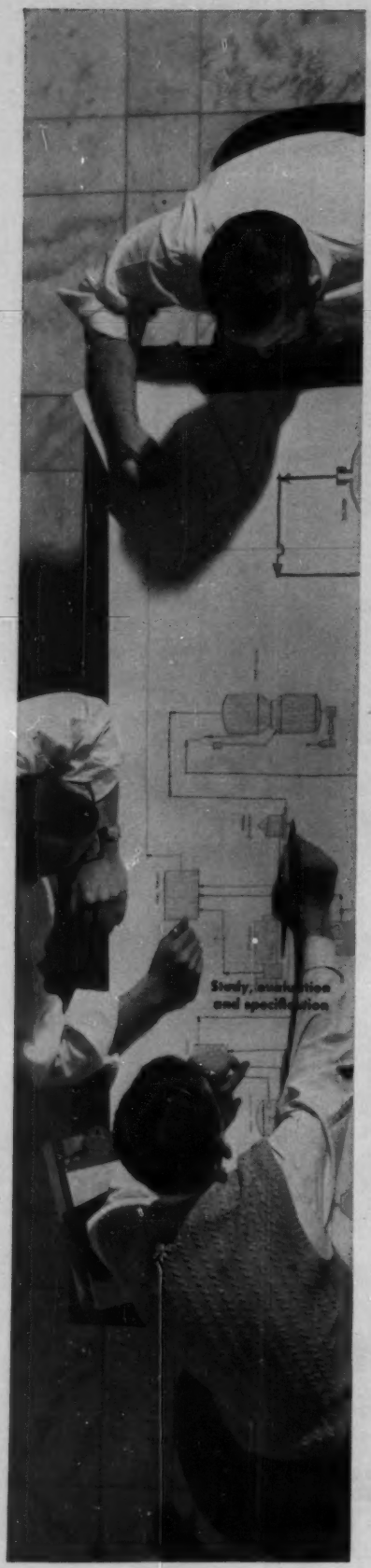


GLASS-LINED CONICAL, ROTARY DRYER-BLENDERS

Standard acid-alkali, glass-lined, conical, rotary Dryer-Blenders available in capacities — 5 and 35 cu. ft. and larger on request; operating temperatures — liner 500° F, jacket 650° F; operating pressures — tank full vacuum to 25 psi, jacket 65-75 psi (50-60 psi with tank at full vacuum).

..... A subsidiary of A.O.Smith Corporation .....

The World's largest manufacturer of glass-lined steel products



Automatic control systems engineered from conception to operation by a single, responsible service

The economy and efficiency of start-to-finish engineering of automatic control systems is available from Panellit's Instrument Services Division. This staff of mechanical, electrical and chemical engineers—all with process experience—offers the broad scope of instrumentation services outlined below. Where management's own instrument and process engineers or contracting organizations are available, Instrument Services Division supplements this personnel and provides specialized experience. Division activities have included major instrumentation projects in the process, power and atomic energy industries and for engine test facilities.

Studies and evaluations of instrument requirements are made, and recommendations are submitted. If desired, detailed specifications are prepared permitting the customer to invite bids on the recommended equipment.

Equipment installation, inspection and check-out are supervised by Division instrument engineers working with factory-trained craft foremen and technicians. Typical field work includes erecting panelboards, installing field-mounted transmitters, making electrical or tubing interconnections, as well as system testing, calibration, and start-up. (Installation services are offered for instrumentation only, not for its associated process equipment.)

Field maintenance of installed instrumentation is also provided by Instrument Services Division on a contract basis.

Overall project coordination of these individual services places entire responsibility for automatic control systems in one qualified organization. Since Panellit is concerned mainly with systems and manufactures no standard instruments available elsewhere, the Division has an impartial approach in recommending system components. Your inquiry is invited.

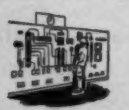
Equipment installation and check-out

Field maintenance

Overall project coordination

INSTRUMENT SERVICES DIVISION

Engineered Information Systems For Industry



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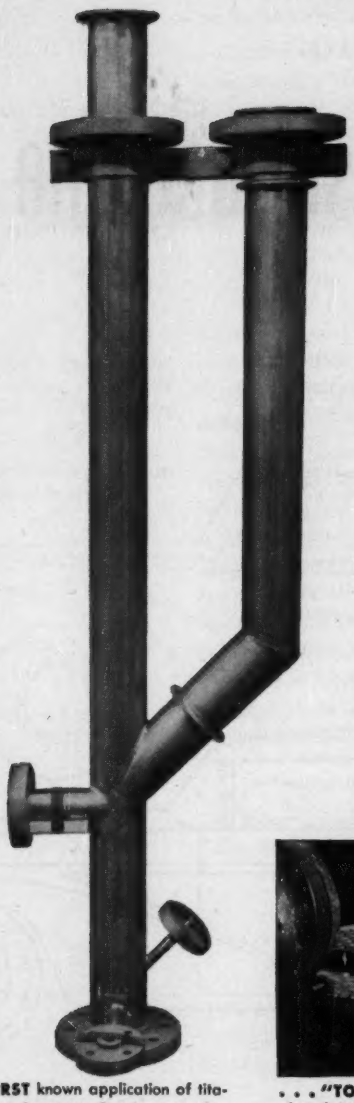
NOW: TITANIUM PIPING

built to weather nitric acid vapors at 195° C and 450 pounds psi



FIRST known application of titanium for piping. Fabricated by The Youngstown Welding & Engineering Co., Youngstown, Ohio, this 4" pipe is 6'8" high, serves under the same conditions as the . . .

The 4" pipe at the left is made of commercially pure titanium. Fabricated by The Youngstown Welding & Engineering Co., it is the first known application of titanium for piping.

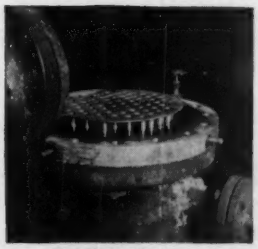
This 6'8" vapor lead-off assembly will be subjected to turbulent vapors of 60% nitric acid at elevated pressures and temperatures. It has a test strength of 450 pounds psi although service pressures will be substantially lower.

"TOP-HAT" PAVES THE WAY

Success with another titanium application in a nitric acid condenser—the "top-hat" insert—led to the realization of a need for titanium piping. The "top-hat" (shown below) is a titanium header with 3" protective sleeves that fit down into the tube bundle of the condenser in which it is used. When in place, it provides protection to the inlet tubes at the point most vulnerable to acid attack.

After 14 months' exposure to 60% nitric acid vapors—8 of them 24-hour continuous duty—sheet, tubes and welds of the "top-hat" were essentially unchanged . . . the assembly showed signs of being able to serve indefinitely!

There are *many* possible applications where titanium can *save money* by extending the service life of essential equipment or reducing maintenance. Titanium's resistance to nitric acid, moist chlorine, solutions of chlorine, chlorinated organic compounds, and inorganic chloride solutions is uniquely superior. Salt water and marine atmospheres have no corrosive effect on titanium.



. . . **"TOP-HAT,"** here being placed into the condenser tube bundle. Tubes of the "top hat" extend 3" into parent tubes protecting them at point most vulnerable to acid attack.

Du Pont can help you start your evaluation tests now

As a pioneer *supplier* of titanium sponge, Du Pont can offer you expert technical help—can put you in touch with manufacturers best equipped to work along with you. Considerable fabricating know-how and a wide variety of mill shapes are *now* available to help solve your corrosion problems. For more detailed information on titanium, check the coupon below. (At present, this offer must be limited to the United States and Canada.)

TITANIUM SPONGE

PIONEERED COMMERCIALLY BY DU PONT

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

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Pigments Department CE-5
Wilmington 98, Delaware
In Canada—Du Pont Company of Canada Limited,
P. O. Box 660, Montreal, Canada

☐ Please send me more information on titanium.
I am interested in using titanium for:_____

_____

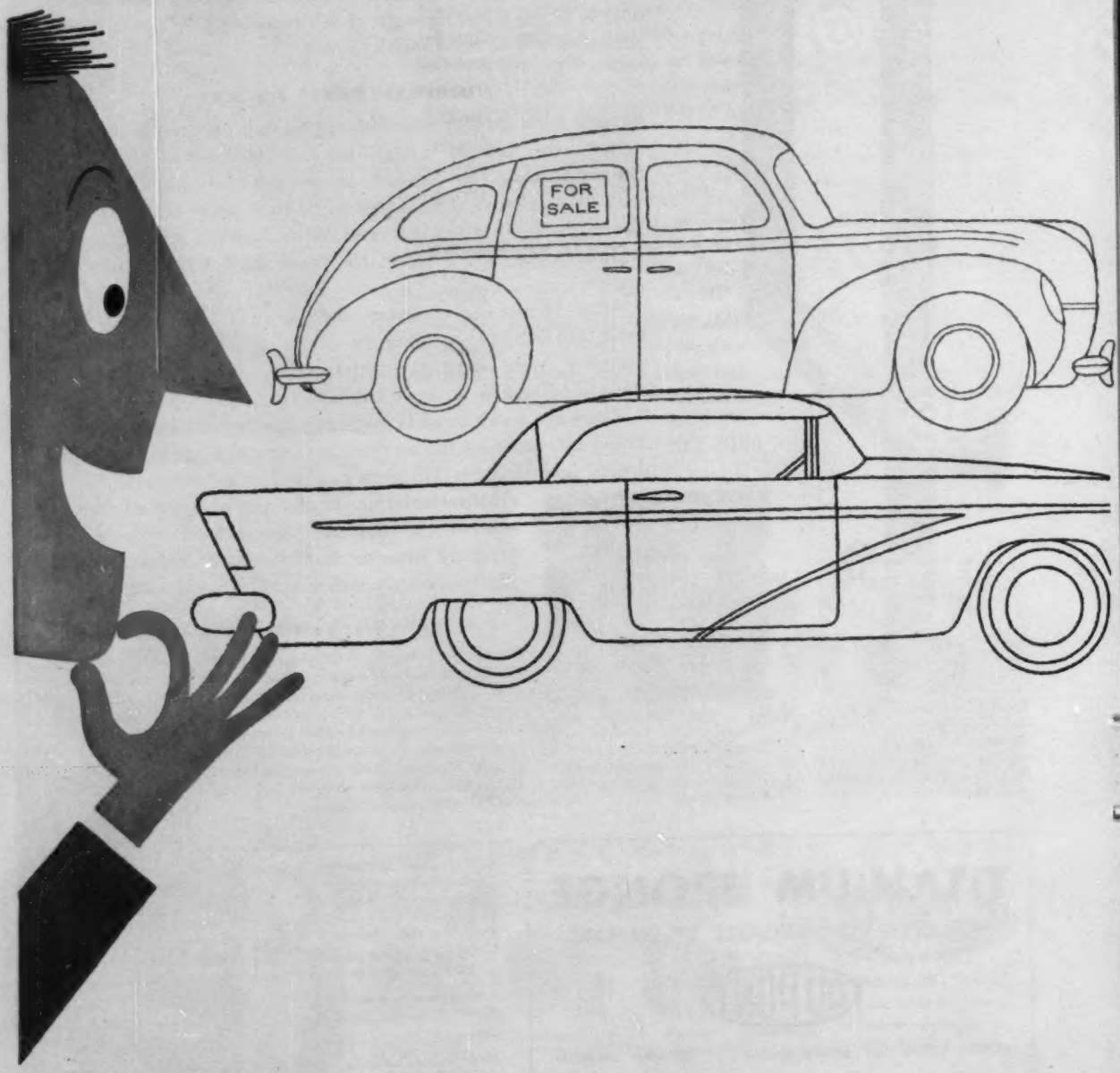
*Name*_____

*Firm*_____ *Position*_____

*Address*_____

*City*_____ *State*_____

compressor designs also become



New automobile designs with startling advances in styling and performance present their appearance every year. Engines considered to be the last word a few short years ago, have been scrapped in favor of new models possessing greater performance and stamina.

Isn't there also a continuing need for improved compressor designs and performance . . . don't they too become obsolete?

obsolete!

To avoid owning a *new* plant that is an antique *before* it starts up, be sure that you insist upon modern compressors.

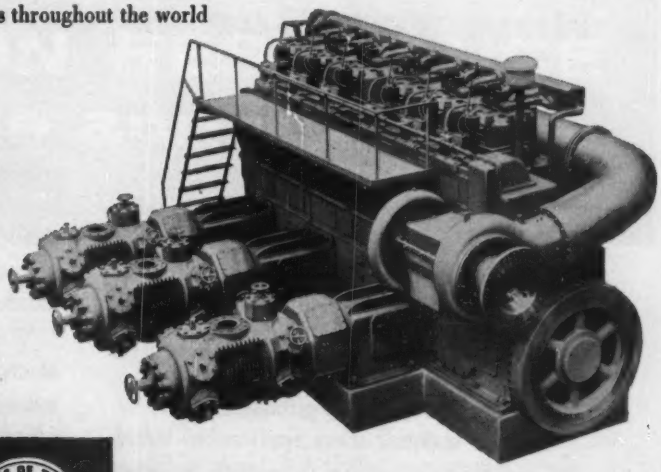
Clark is the only source of MODERN compressors that are specifically designed and built as turbo-supercharged units.

This means high power output—up to 65% more, without cutting into overload capacity or safety factor. Furthermore, a 10–15% reduction in fuel consumption plus a 40% saving in cooling cost is a direct result of turbo-supercharging.

Though Clark Model TLA and TRA Turbo-Supercharged compressors are modern designs, they have already been proved in numerous installations. They are built in 1100–3400 BHP models.

If you would like further details on the advantages of buying MODERN turbo-supercharged compressors to match your other up-to-date equipment and facilities, call your nearest Clark office or write for bulletins No. 134 and 145.

CLARK BROS. CO. • OLEAN, N. Y.
One of the Dresser Industries
Sales offices in principal cities throughout the world



Clark Model TLA-6 2000BHP Turbo-Supercharged, 2-cycle, gas-engine-driven compressor

CLARK®

Turbo-Supercharged Compressors

Simple Arithmetic...
Type 302, Sheet Base Price 44.50 cents per lb.
Type 430, Sheet Base Price -34.50 cents per lb.
Saving 10.00 cents per lb.
in Stainless SHEET Costs!

Now You Can SAVE $200 Per Ton!

Many designers and fabricators who are currently using Type 302 stainless can, in numerous applications, specify Type 430 straight chromium stainless and take advantage of the 10 cents per pound difference in base price. Some of our customers are already saving more than $200 per ton using our 430 MicroRold stainless sheet.

The steel industry estimates that 50% of all stainless sheet applications could satisfactorily employ Type 430, the least expensive of all stainless grades, as an economical and practical material. When properly applied, Type 430 has all the desirable qualities of beauty, corrosion resistance, strength, long life and low maintenance that no other material, except stainless, can offer.

We are currently producing our MicroRold Type 430 sheets in thicknesses .005" to .109" with 2B or 2D finishes; and in thicknesses .010" to .109" in No. 3, 4 and 7 finishes.

Send for Your copy, "Care and Use of 430 MicroRold Stainless Steel"

Washington Steel *Corporation*

5-S WOODLAND AVENUE, WASHINGTON, PA.

US RUBBER EXPANSION JOINTS

U. S. Rubber Expansion Joints insulate pipe lines against vibration, allow for expansion and contraction—*and* resist corrosion from the outside as well as inside.

These flexible pipe line connections resist attacks by acids, oils, chemicals, and abrasive materials. Even the flanges are rubber faced. And the continuous flexing of the rubber *prevents scale from forming.*

More and more chemical processing plants are turning to U. S. Rubber Expansion Joints because they are not only corrosion resistant, but also extremely durable. There are no moving parts to wear out.

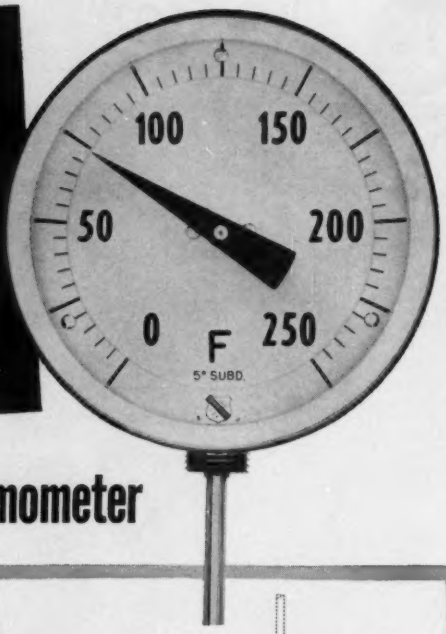
U. S. Rubber Expansion Joints are readily installed on both new and old pipe systems. They are available, along with skilled engineering service, at any of the 28 "U. S." District Sales Offices. Or write us at Rockefeller Center, New York 20, N. Y.

US RUBBER

Mechanical Goods Division

United States Rubber

"Every Angle" Design Maxivision® Accuracy Bi-Metal Actuation

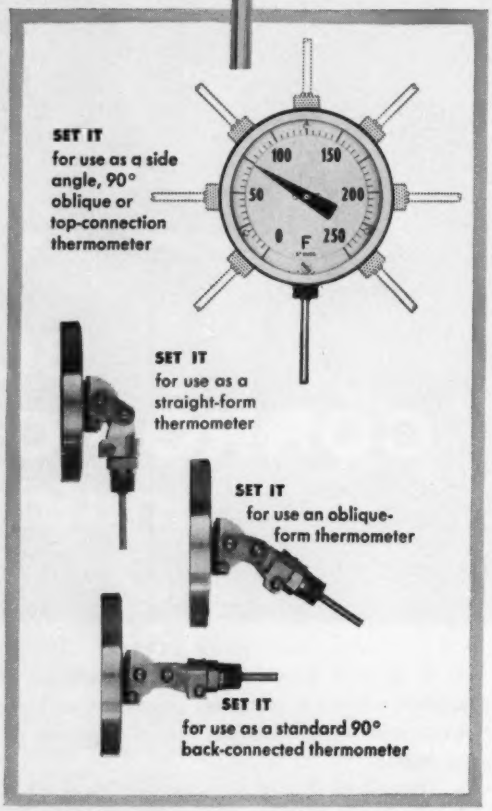


Now... all 3 in one 'American' Thermometer

Only this new American Thermometer* gives you the three features most demanded in a dial thermometer. The "Every Angle" design allows you to install this thermometer *anywhere* . . . then angle it in the direction that provides easiest reading. The anti-parallax Maxivision dial guarantees the surest, sharpest, easiest reading. Graduations are carried on a raised ring, set close to the cover glass, with an index-type, functional pointer set at the same level. The result – no perspective effect – parallax error practically eliminated. Finally, bi-metal actuation insures high sensitivity, economy, and surety of operation.

Install the new American "Every Angle" Bi-Metal Dial Thermometer anywhere – inside or out. Its climate-proof case defies any weather condition. The full use of these thermometers in any process plant makes possible temperature readings with the same ease and facility of those of a pressure gauge. Write today for complete information. Ask for Bulletin 148.

*Pat. App. For


SET IT
for use as a side angle, 90° oblique or top-connection thermometer
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for use an oblique-form thermometer
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for use as a standard 90° back-connected thermometer

SPECIFICATIONS

5-Inch Type 5-6060 American "Every Angle" Bi-Metal Dial Thermometer

Temperature Ranges: From minus 80° to plus 1000° F. Accuracy within 1% of range. *Dial Size:* 5". Scale approximately 10½" long. *Bi-Metal Coil:* Low mass, with single helix close to inside wall of stem assures high sensitivity. Silicone fluid dampens vibration, accelerates transfer, speeds response. *Case:* Stainless steel. *Bezel:* Threaded to case. *Front:* Clear, extra-heavy glass set in channeled gasket to seal case. *Pointer:* Functional type, adjustable from front. *Stem:* Lengths – 4" to 24", 18-8 stainless steel. All joints welded. *Connection:* Fixed, ½" NPT. *Separable Sockets:* Available in all materials and sizes normally required.

PHONE your Industrial Supply Distributor for experienced attention to your needs. He is always ready to help you ward off costly shut-downs through fast delivery from local stocks.

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A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

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EAGLE-PICHER
SUPER "66"
INSULATING CEMENT

AND BECAUSE IT STICKS IT—

- Saves time! Applies quickly to any equipment, cold or heated to 1800 F.
- Saves money! Provides far greater coverage and more efficient insulation.
- Gives maximum fuel savings! Unique "springy ball" structure of small, resilient pellets of mineral wool, has thousands of dead air cells.
- Makes difficult jobs easy! Can be used on irregular shapes where application of other insulations is often impossible. Usually requires no reinforcing on applications up to 1½ inches thick.
- Prevents rust! Super "66" contains a special rust inhibitive that actually prevents corrosion.

FREE SAMPLE! WRITE TODAY!
See how Super "66" *really sticks* for easy application wherever insulation is needed!

(Member of Industrial Mineral Fiber Institute)

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(Conforms to Commercial Standard CS 117)

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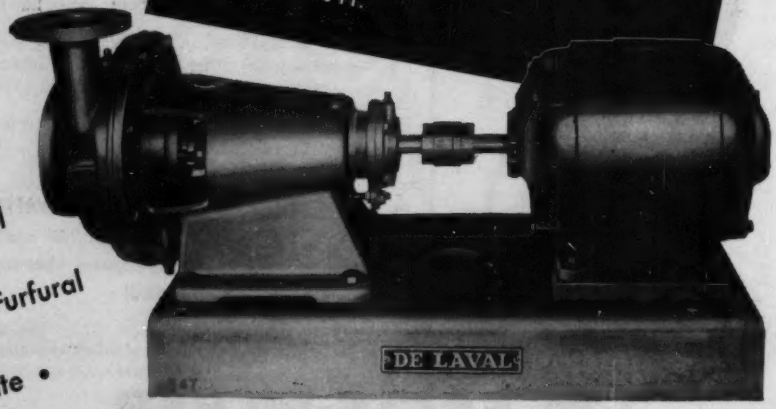
One pump handles all these liquids...

DE LAVAL CPO PROCESS PUMP

CAPACITIES TO 2,000 GPM
HEADS TO 200 FT.



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DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY
803 Nottingham Way, Trenton 2, New Jersey

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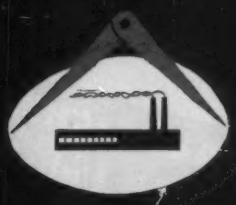
DU PONT ELASTOMERS

NEOPRENE-HYPALON®



in Industry

Tank linings of HYPALON® for extra-high resistance to oxidizing agents

Long-lasting protection for storage and processing tanks handling some of the *strongest* oxidizing agents is now possible, thanks to tank linings of HYPALON, Du Pont's new synthetic rubber. These are the special applications where severe service conditions justify the use of a special-purpose elastomer coating.

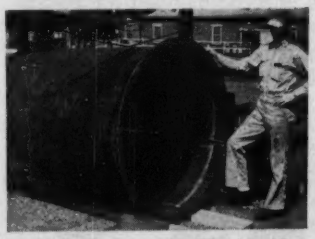
Applied by standard lining methods, resilient linings of HYPALON resist deterioration from such chemicals as chromic acid, sodium hypochlorite and pickling solutions. For the complete list of chemicals to which HYPALON has superior resistance, use the coupon below.

The resistance of HYPALON to chemical attack suits it well for *particularly demanding jobs* in the chemical industry. Its extra-long service life can mean savings in replacement and maintenance in each of these products:

- Acid hose
- Gasket and packing
- Tank linings
- Protective coatings
- Molded parts
- Roll coverings

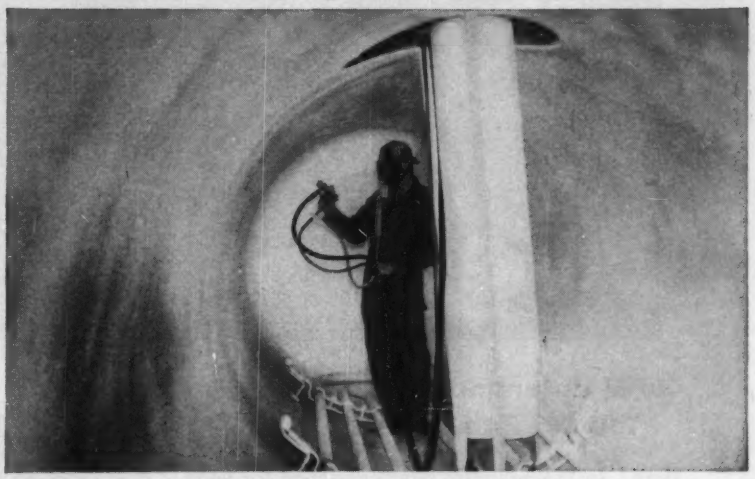
Other properties of HYPALON include exceptional resistance to heat, complete ozone resistance and resistance to abrasion and flex cracking.

Remember the name HYPALON when a rubber product is needed that must withstand the most severe oxidizing conditions in your laboratory or plant.



THERE IS A LONG service life ahead for this tank section used for storage of calcium hypochlorite. It's lined with HYPALON.

NEOPRENE coatings give 5 years' service in tank cars carrying hot concentrated caustic



WHITE NEOPRENE LINING is sprayed on the interiors of tank cars used to ship hot, concentrated caustic soda.

Neoprene coatings have solved the problem of transporting and maintaining the purity of rayon-grade caustic for the Columbia-Southern Chemical Company, one of the largest caustic-soda producers in the country. Used as a lining in hundreds of tank cars, these durable coatings prevent iron contamination and are giving an average of 5 years' service.

The neoprene linings successfully withstand the attack of 50% and 73% caustic soda shipped at temperatures ranging from 145° F. to 250° F. The linings can be applied in about 72 man-hours, including sandblasting, vacuum cleaning, application of two brush coats of chlorinated rubber primer and 12 to 14 spray coats of neoprene latex resulting in a coating of 20 mils.

The neoprene coatings have served so satisfactorily in tank cars that Columbia-Southern has adopted the same type lining for storage tanks and as a coating for tank-car exteriors.

This is a typical example of how neoprene can reduce maintenance costs. Its service record is also exceptional where exposure to oil, heat, chemicals or weather is a factor. For more information about neoprene used in hundreds of other products such as gaskets, hose, cable or gloves, fill out and mail the coupon below.

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HYPALON *is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.)*

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Please send further literature and add my name to the mailing list for your free publications, the "Neoprene Notebook" and "Facts about HYPALON®," which show how the Du Pont elastomers are used in improving products and cutting maintenance and replacement costs.

E. I. du Pont de Nemours & Co. (Inc.)
Elastomers Division, Dept. CE-5
Wilmington 98, Delaware

Name_____ **Position**_____

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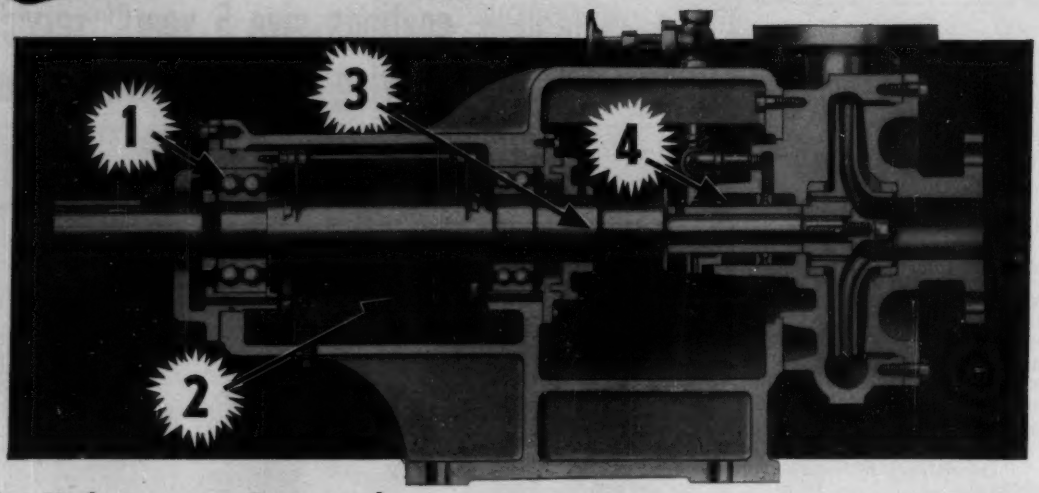
Address_____

City_____ **State**_____

ALLIS-CHALMERS

Oil-Lubricated Chemical PUMP

4 Check these Quality Spots



Cut Maintenance Costs and You Cut Pump Costs!

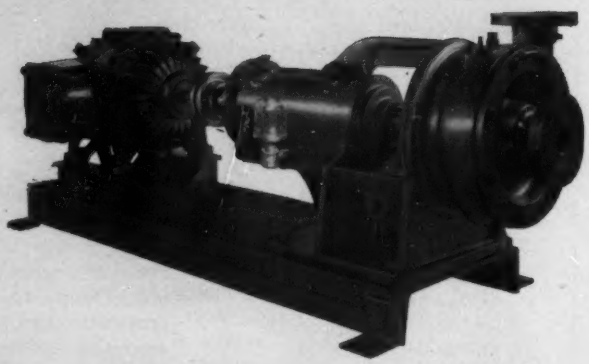
Here's an "all-around" pump designed for your industry. It costs hundreds of dollars less than refinery pumps — yet does many of the same jobs. It costs a little more than grease-lubricated pumps — yet more than makes up the difference by cutting maintenance.

It's a quality pump throughout. As shown above, it has:

1. Double-row oil-lubricated bearings with positive end closures suitable where acid or alkali vapor or abrasive dust is present.

2. Oil lubrication — which does away with the most common cause of bearing failure — overgreasing. Oil lubrication also permits operation at higher temperatures.

3. Heavy shaft — holds alignment, reduces wear of parts. Either high grade carbon steel or stainless steel is provided, depending on application. Pump can be supplied with or without shaft sleeve as desired.



4. Alternate sealing arrangements — Any one of six different sealing arrangements can be provided, including a water-cooled stuffing box where the liquid being pumped is above 250 F.

Allis-Chalmers builds many types of pumps, but this particular type is recommended for pumping liquors, corrosive materials and solutions in the most used ratings to 3500 gpm, heads to 400 feet for liquids to 550 F.

A-4570

For complete information call your nearby A-C office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin, for Bulletin 52B7638.

ALLIS-CHALMERS

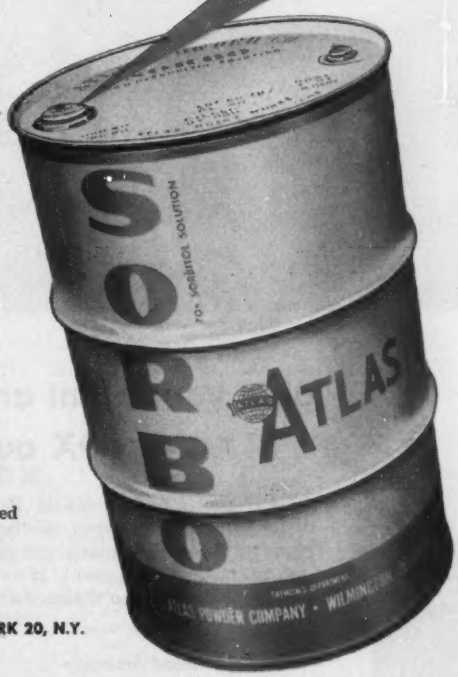
Here's how ATLAS uses *Tri-Sure*® Closures to prevent contamination

Sorbo†—a moisture conditioner that is widely used in the pharmaceutical, cosmetic and food industries—is one of many important new chemicals developed by Atlas Powder Company.

Atlas produces Sorbo and other chemicals under conditions that maintain utmost purity throughout processing. And to assure the *delivery* of a pure product to every customer, the entire line of Atlas Chemicals shipped in steel drums is equipped and sealed with *Tri-Sure* Closures.*

Atlas uses Tri-Sure Closures to be sure of tight, leak-proof, tamper-proof drums. And for additional protection against the possibility of contamination, Atlas specifies the combination of the Tri-Sure *Aluminum Flange* and Tri-Sure *Polyethylene Plug* which offer complete protection for Sorbitol emulsifiers and other Atlas Chemicals.

Whether your products are chemicals, foods, oils, paints or drugs the best closures for your containers are *Tri-Sure.* Adopt the time-tested practise that is *standard* with the world's leading shippers:—when you order drums always specify *"Tri-Sure Closures".*

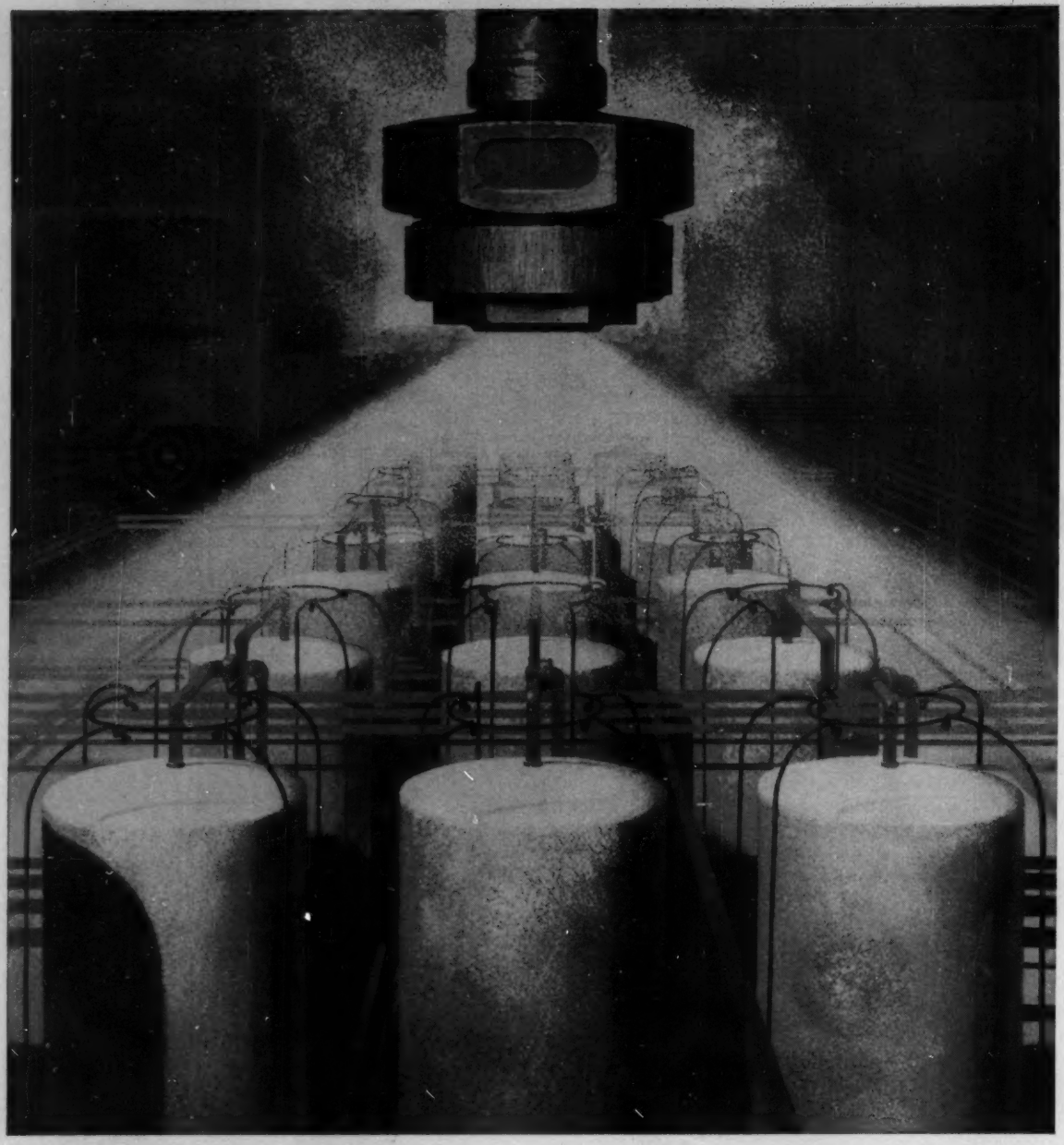


Always specify **Tri-Sure** Reg. U. S. Pat. Off. **CLOSURES**

†Sorbo (70% sorbitol solution) is a registered trademark of Atlas Powder Company.

*The Tri-Sure Trademark is a mark of reliability backed by over 35 years serving industry. It tells your customers that genuine Tri-Sure Flanges (inserted with genuine Tri-Sure dies), Plugs and Seals have been used.

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.
CHICAGO, ILL. • NILES, OHIO • LINDEN, N. J.
Tri-Sure Products Limited, St. Catharines, Ontario, Canada
Tri-Sure S/A Indústria e Comércio, Sao Paulo, Brazil
B. Van Leer N. V., Stadhouderskade 6, Amsterdam, Holland
Van Leer Industries, Ltd., Seymour House, 17 Waterloo Place, Pall Mall S.W. 1, London, England

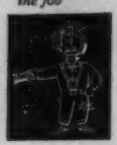


give your plant and equipment the best fire protection— a BLAW-KNOX automatic fog system

BLAW-KNOX Automatic Fire Protection Systems are engineered to provide positive protection for your plant and processing, storage, and other equipment. If a fire breaks out, the system goes into action immediately:

- alarms sound
- fire smothered *promptly*
- heat dissipated by *cooling* action
- pressure build-up prevented

Why not give your plant and equipment the BEST possible protection. Let a Blaw-Knox *fire-protection* Engineer study your needs. He will gladly submit a layout and a cost estimate . . . with no obligation to you.



"Little Joey Sprinkler always on the job"

50th Anniversary BLAW-KNOX 1906-1956

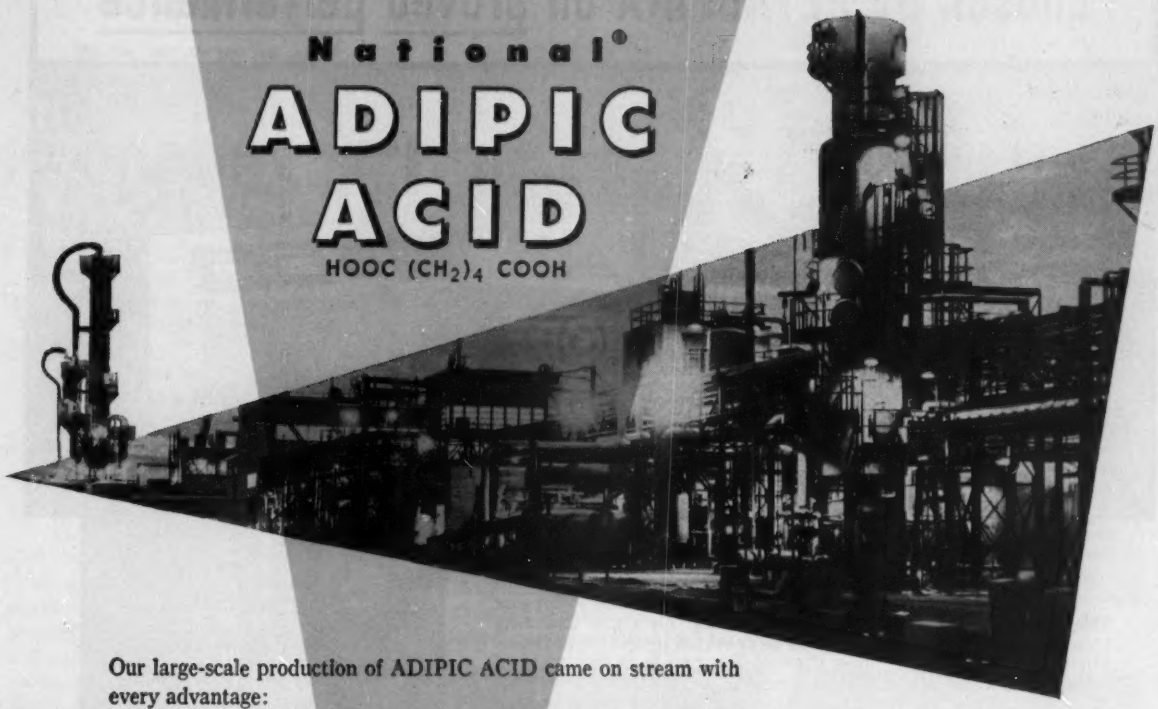
BLAW-KNOX COMPANY
Automatic Sprinkler Department
Pittsburgh 33, Pennsylvania

Sets a new high standard of quality

National®

ADIPIC ACID

$HOOC(CH_2)_4COOH$



Our large-scale production of ADIPIC ACID came on stream with every advantage:

A brand new plant Allied Chemical-integrated right back to basic raw materials.

An efficient, continuous process yielding an outstandingly high quality product—99.7% minimum purity, light color and low iron.

If you make or contemplate making adipates, adipic polyesters or polyurethans, you should investigate the advantages of National ADIPIC ACID. It can be used with complete satisfaction in the rubber, plastics, plasticizer, lube oil and chemical industries. We will be glad to send samples, technical data and quotations.

SEND FOR TECHNICAL BULLETIN I-12

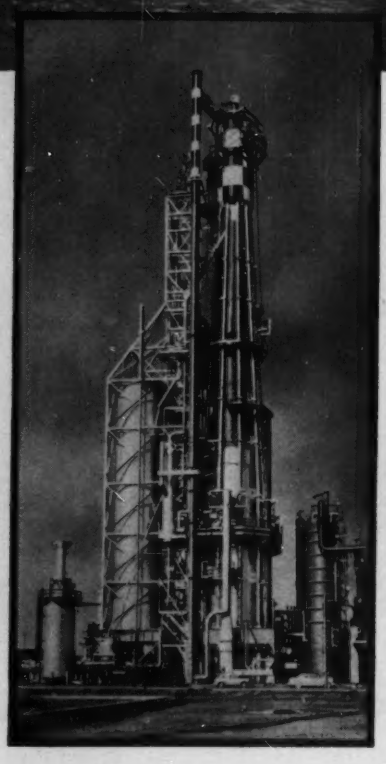
This comprehensive 8-page technical bulletin on National Adipic Acid gives physical and chemical properties; principal reactions of the carboxyl and alpha methylene groups; solubility curve, and suggested uses with copious literature references.

NATIONAL ANILINE DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N. Y.

Boston Providence Charlotte Chicago San Francisco Atlanta Portland, Ore. Greensboro Philadelphia Richmond Cleveland Los Angeles Columbus, Ga. New Orleans Chattanooga Toronto

Allied Chemical

"American-Microsen" Electronic Control chosen by PETROFINA on proved performance



Photos courtesy The Lummus Company, New York, N. Y. and Canadian Petrofina Ltd., Montreal, P. Q.

This is the new refinery of Canadian Petrofina, Ltd., at Point aux Trembles, Quebec. Located here is the first Catalytic Cracking Unit in the Western Hemisphere to be operated by the "American-Microsen" Electronic Process Control System. It is the latest of hundreds of installations that have proved the reliability and practical advantages of "American-Microsen" control for refineries and chemical plants.

This Petrofina installation demanded long-distance transmission and difficult control applications, but start-up was completed ahead of schedule—to the benefit of refinery and contractor. *And the installed cost of the instruments was the same as for conventional controls.*

The long list of successful "American-Microsen" applications includes plant-scale operation of numerous critical petroleum and chemical processes. Conventional instruments could not control some of these processes, but they are handled easily by "American-Microsen" because of its speed of response, sensitivity and lag-free transmission. Many of these installations have been functioning well over a year, without maintenance problems, and with the enthusiastic approval of users.

You want better control and simplified servicing in automating your processes for higher product quality and greater economy. The "American-Microsen" Electronic Process Control System assures both—on new units and those now impossible to control satisfactorily. Invite one of our field sales engineers to help you determine the best equipment for your requirements without obligation, of course.

MANNING, MAXWELL & MOORE, INC.

INDUSTRIAL CONTROLS DIVISION, STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN-MICROSEN' ELECTRONIC TRANSMITTERS, INDICATORS, RECORDERS, CONTROLLERS, ELECTRO-PNEUMATIC VALVE POSITIONERS AND ELECTRO-HYDRAULIC CONTROL VALVE OPERATORS.

"Used many makes of turbines... PREFERS COPPUS"

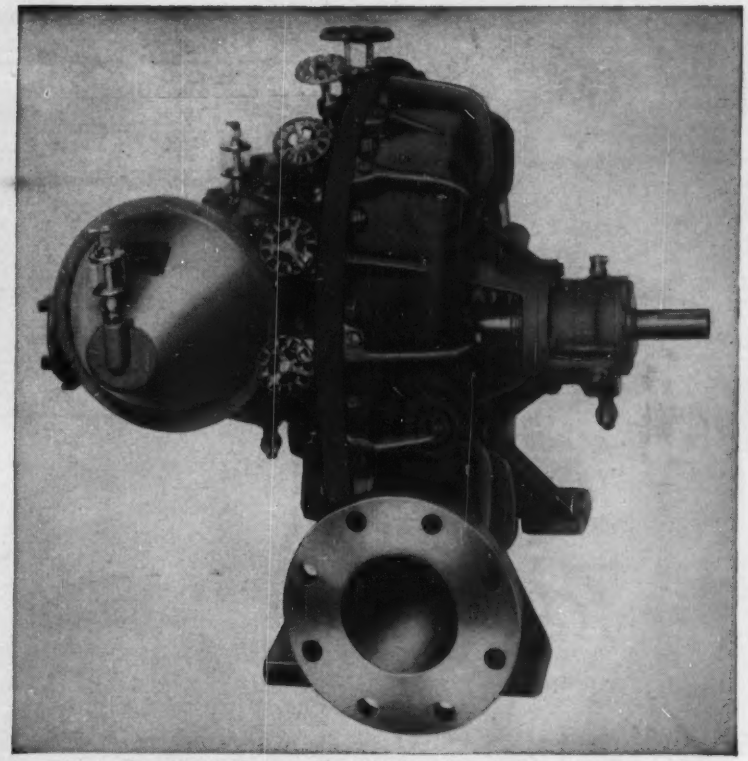
If you want to know about turbine performance, ask an *operator*. He *knows*. And, in the words of one of them:

> "I have had occasion in the past to operate many makes of turbines. The plant in which I am now employed is almost entirely Coppus equipped on our auxiliary equipment. I find your turbines most satisfactory and would like to congratulate you on your design."

Whether you use a Coppus with a regular wheel or wide bucket "L" type you get these *proven* features:

- Turbines rated close to your hp requirements from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.
- Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbine.

COPPUS ENGINEERING CORPORATION
225 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

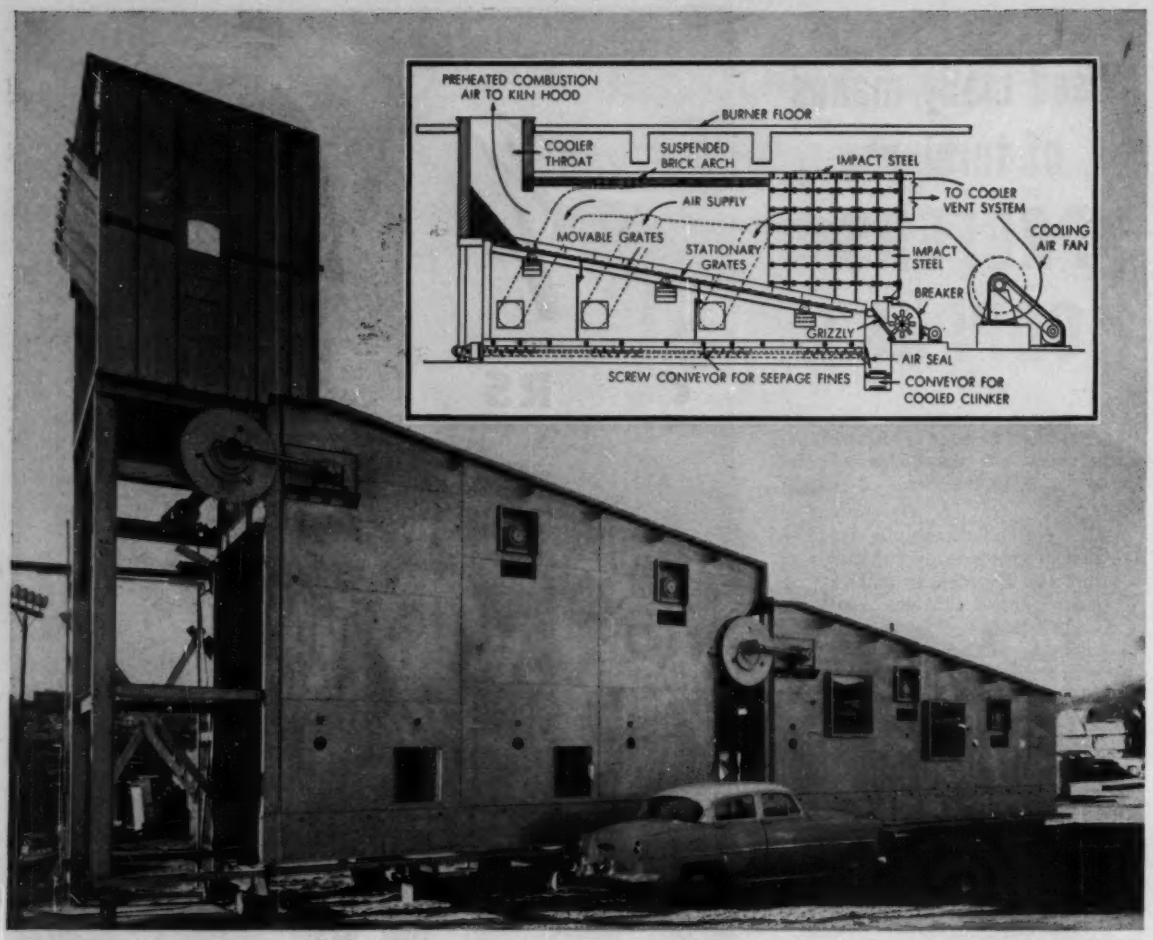


This is the reliable Coppus Turbine furnished with either a regular wheel or wide bucket "L" type wheel.

This wide bucket "L" type wheel is a new development for use where low water rate is essential.

This is the regular wheel used on Coppus Turbines which have been so highly satisfactory throughout industry.

COPPUS "BLUE RIBBON" TURBINES



BIGGER and BETTER . . .

and, MORE and MORE of them!

Fuller Coolers are spreading out, both in size and in various industrial applications. Above is one of two coolers, assembled at our Catasauqua plant, sold to a large chemical company for cooling of phosphate nodules discharged from a rotary kiln. Temperature of the nodules is reduced from 2400-deg.F. to 250-deg.F., at rate of 1500 tons a day. The cooler has a grate surface 10 feet wide by 60 feet long, the largest ever built by Fuller.

These king-size coolers will be equipped with automatic controls for variable grate speeds, supplying uniformly preheated air at 1300 to 1350-deg.F. for combustion in gas-fired rotary kilns, resulting in a substantial saving of fuel. Each cooler installed, with its refractory lining, will weigh in the neighborhood of 250 tons.

Well over 100 Fuller Coolers have been sold to the chemical process industry during 1955 . . . truly an unqualified endorsement of the efficient performance of this equipment.

In addition to phosphate nodules, Fuller coolers are today handling materials such as pebble lime, dolomite, iron nodules and Portland cement clinker, with the characteristic Fuller efficiency that is the result of long experience and knowledge of industry needs.

Possibly you have a cooling problem which could be solved with a Fuller Cooler. Why not get in touch with a Fuller engineer, who will be glad to discuss the matter with you in detail. Bulletin CO-5 gives full details of this equipment. Write for a copy today.

Fuller
designers and builders of better equipment always

FULLER COMPANY
GENERAL AMERICAN TRADE MARK

FULLER COMPANY

134 Bridge St., Catasauqua, Pa.

SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORP.

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CO-31
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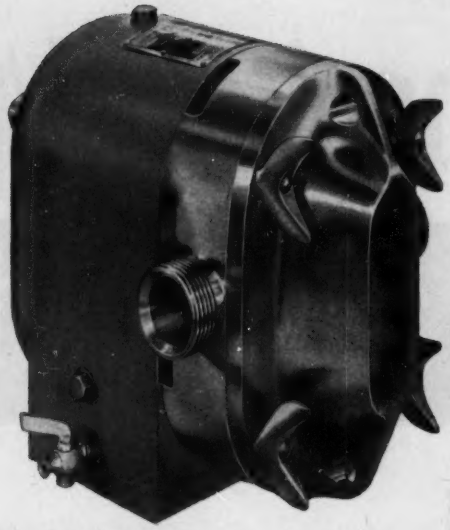
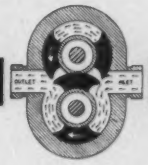


ONLY Waukesha OFFERS ALL 3 IN A PUMP!

1 POSITIVE DISPLACEMENT



... for smooth, even pumping action—no agitation, no pulsation, no areation. Slow speed ... positive displacement ... no priming.

2 CORROSION-RESISTANT

... manufactured from Waukesha Metal or Stainless Steel —completely corrosion-resistant. Metal will not react chemically with the product or contaminate the flavor.

3 SANITARY

... simple to disassemble, wash, sterilize, and reassemble. The Waukesha O-Ring Seal completely seals out air ... completely seals your product in.

... IT PUMPS MANY CORROSIVE SOLUTIONS WITHOUT LEAKAGE

Designed for "tough" pumping jobs in the chemical industry where volatile, corrosive or hot materials of low or high viscosity are being transferred, is the Waukesha positive displacement pump with the spring-loaded John Crane rotary seal. This pump and seal combination minimizes leakage problems.

Waukesha corrosion-resistant pumps are renowned for their precision performance and dependable operation. With positive displacement pumping, you eliminate the turbulence, churning, agitation and aeration so damaging to most products. With smooth product flow you reduce your plant processing problems.

Waukesha has a pump to serve you in the chemical, textile, pharmaceutical, rubber, petroleum and chemical industry.

Write for Complete Pump Information

WAUKESHA FOUNDRY COMPANY, Dept. P, Waukesha, Wisconsin

Complete Line of Pumps

Sizes—Inlet and outlet ports from 1" to 3" dia.

Capacities — 1/10 to 100 gal./min.; 20 lbs. to 60,000 lbs./hr.

Head Pressures—Up to 100 psi.

Types—Standard, vented cover, High Boy, V-belt, variable speed, portable.

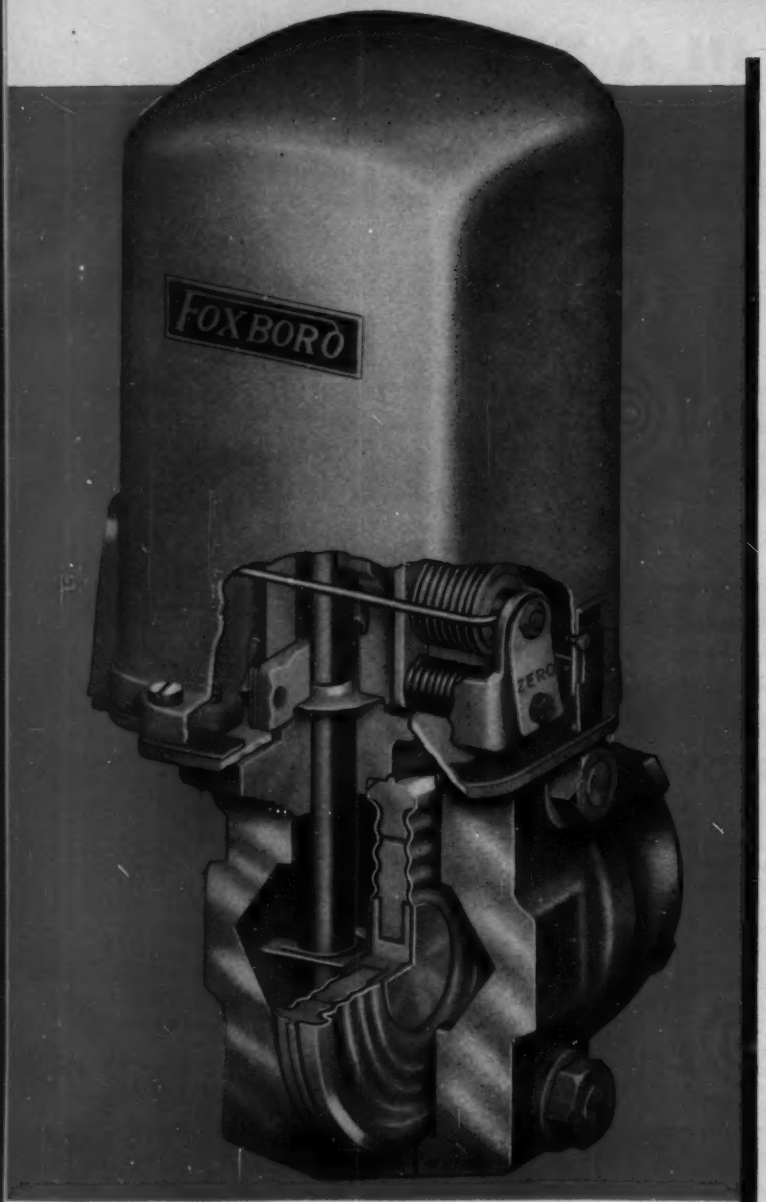
Tpyical Products Pumped

Typical corrosive solutions: acetate solvents, ammonia chloride, aniline dyes, barium chloride, butyric acid, chlorinated water. Also: starch past, alcohol, cold creams, synthetic hormones, cellulose, film dope, ink, lard, paints, syrups.

Waukesha Foundry Company

WAUKESHA—the Forward Look in Pumps. Yesterday, Waukesha Pioneered the Sanitary P.D. Pump. Today, Waukesha Pioneers the Improvements.

ONLY the Type 13A d/p has these 6 advanced-



- **Positive Overrange Protection** up to full 1500 lb. rating
- **Fully Adjustable Ranges . . .** 0-20″ to 0-80″ and 0-50″ to 0-250″ H_2O differential
- **Automatic Internal Damping** . . . fast, *stable* measurement
- **Simplicity** . . . easiest, lowest cost installation, least maintenance
- **Convenient Zero Adjustment** . . . external — no need to remove weatherproof cover
- **Highest Sustained Accuracy** . . . even under extreme operating and ambient conditions

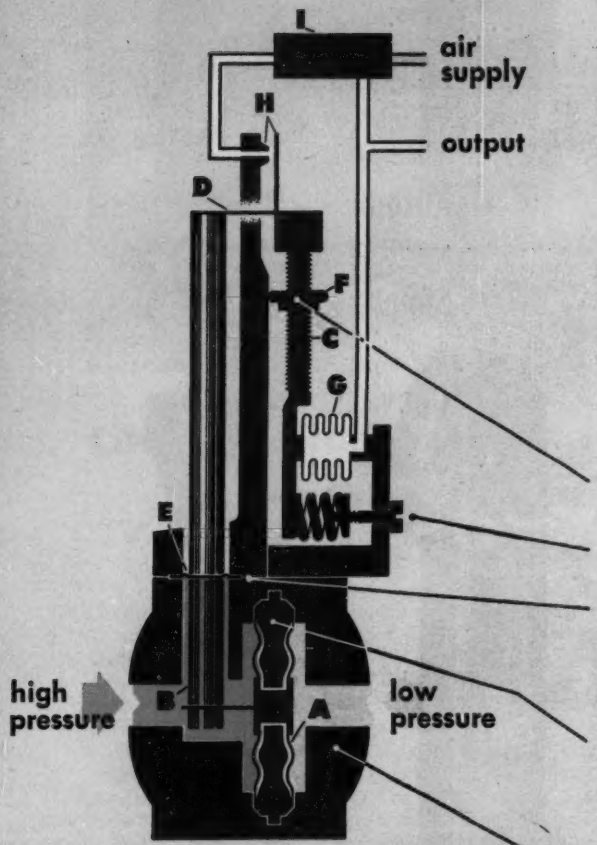
With these basic features, plus many other technical refinements throughout, the new Type 13A d/p Cell* Transmitter surpasses all previous records in performance . . . economy . . . convenience. For the complete story and a demonstration, call your nearest Foxboro representative. Write for new Bulletin 13-11. **The Foxboro Company, 365 Neponset Ave., Foxboro, Mass., U.S.A.** Factories in the United States, Canada and England.

*Reg. U. S. Pat. Off.

More Foxboro flow transmitters are in use by the process industries than all other makes combined!

Cell Flow Transmitter

design features...



How It Works...

An increase in differential pressure across Twin-Diaphragm Capsule (A) exerts force to right on force bar (B). Elgiloy® diaphragm seal (E) acts as fulcrum. Force to left at top of bar (B) causes flapper to approach nozzle at (H). Resulting increase in nozzle pressure is amplified by relay (I). This pressure is sent to feedback bellows (G) which develops force to counterbalance the differential pressure on capsule (A). The 3-15 psi output signal from relay (I), always precisely proportional to differential pressure, is transmitted to remote recording or controlling instrument.

Range Wheel is continuously and easily adjustable for entire range whether 0-20" to 0-80" or 0-50" to 0-250" H_2O.

Easy-access screw adjustment permits field "zeroing" without removing weatherproof cover.

Elgiloy® stainless alloy diaphragm seal assures a corrosion-resistant, frictionless, positive pivot point. Instrument is constructed in 3 basic units — body, transmitter, and air relay block — eliminating all possibility of errors produced by piping stresses.

Silicone-filled Twin-Diaphragm Capsule filters out flow disturbances ("noise") at measurement source . . . without loss of speed of response. Precisely matched surfaces of diaphragms and capsule core provide "stops" which give positive overrange protection in both directions.

Rugged forged body, optionally Type 316 S.S. or carbon steel, gives greatest strength with least weight . . . ultra-compact design permits low cost mounting from flange taps.

FOXBORO
Reg. U.S. Pat. Off.

First in Flow Instrumentation

Here's How

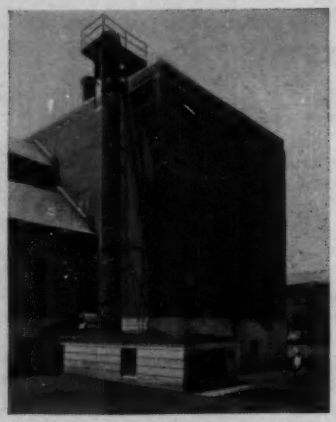
you can lower the cost of elevating

LINK-BELT will recommend the right bucket elevator from 13 types in 4 basic designs

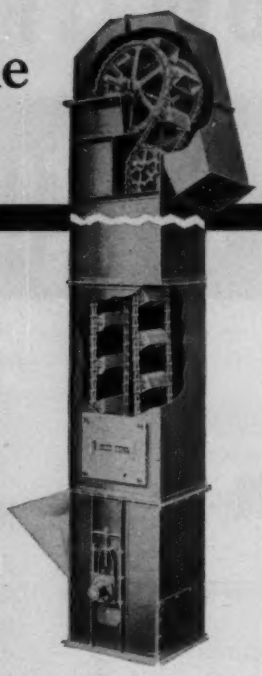
YES, not only does Link-Belt make bucket elevators for all types of material — there is specialization right down to spacing of buckets . . . the types of take-ups and hoods for utmost effectiveness. In addition, Link-Belt offers a wide range of buckets for further assurance of maximum efficiency in handling your materials.

Installation, maintenance and operating costs are low with Link-Belt Bucket Elevators. Rigid, jig-built casings are self-supporting requiring only occasional lateral tie-ins depending on height. You have quick access to both head and boot for periodic inspections. Simple screw or gravity take-ups maintain chain or belt tension always.

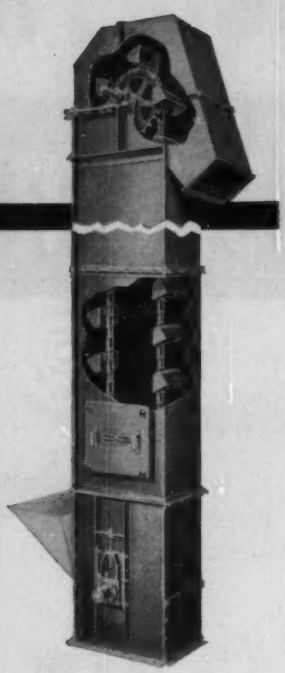
To be sure of a bucket elevator system tailored correctly for your needs, include Link-Belt in the designing of your next plant. Get in touch with a materials handling expert through your nearest Link-Belt office.



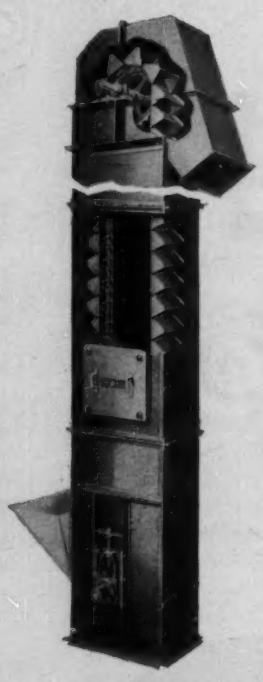
Link-Belt 75-ft. high bucket elevator lifts material from truck dump hopper to storage bin via screw conveyor. Casings need only occasional tie-ins depending on height.



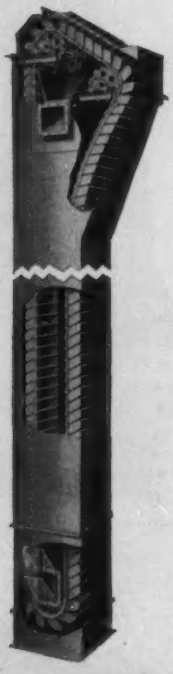
Positive discharge for light, fluffy and fragile materials or materials that have a tendency to stick to the buckets.



Centrifugal discharge for free-flowing, fine or loose materials with small to medium lumps.



Continuous discharge for range of materials — light to heavy, small to large, abrasive lumps.

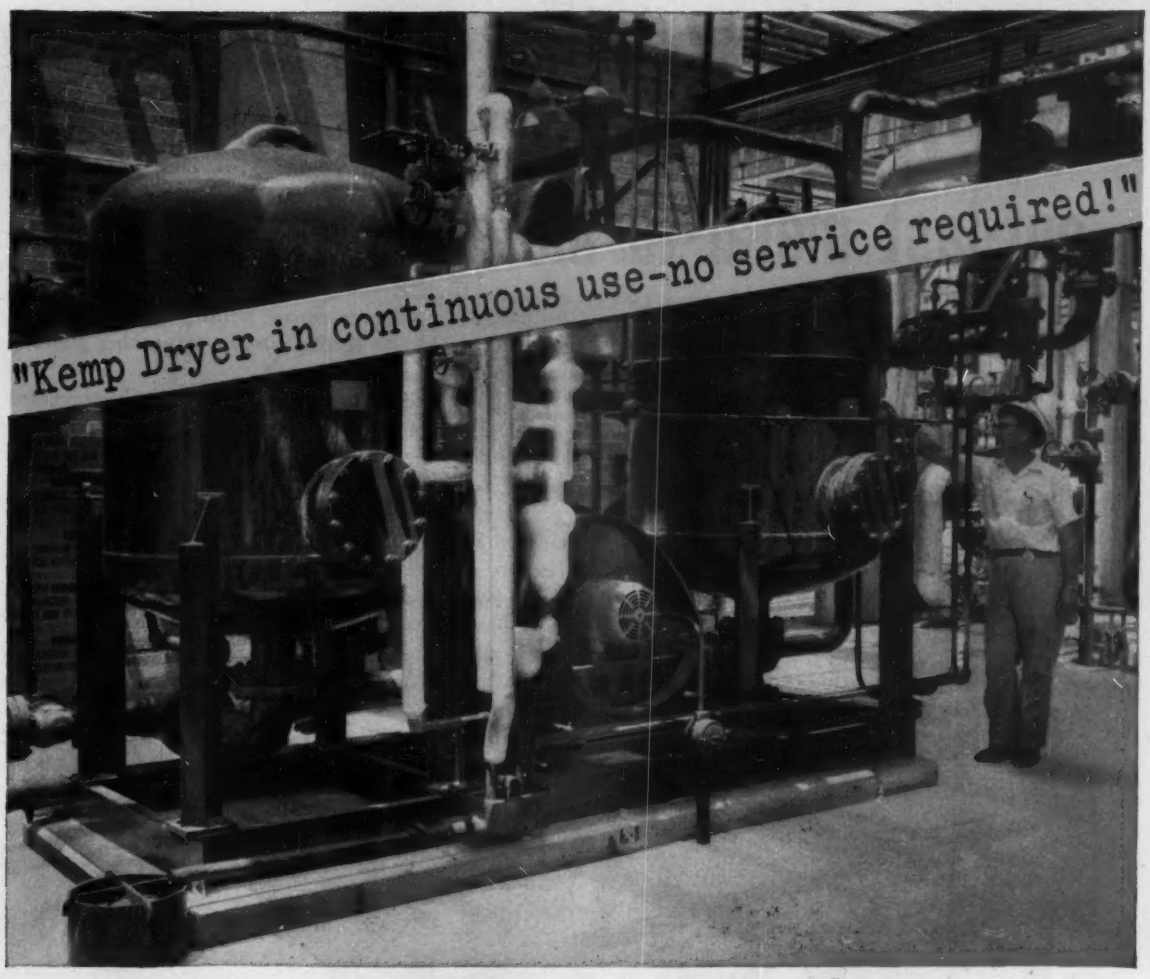


Internal discharge for gentle handling of small articles such as pellets, seeds, castings.

LINK-BELT

BUCKET ELEVATORS

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World 13,786



Cities Service Petroleum reports:

Kemp Dryer in continuous operation 7 days a week; has required no service or downtime!

To dry compressed air for instruments in a hydroformer unit at its refinery in Lake Charles, Louisiana, Cities Service Refining Corporation has installed a Kemp Model LC SE2 Air Dryer. Since January, 1955, it has served continuously—seven days a week—drying 1900 cubic feet of air per minute to a dew point of −10° F.

This fully automatic Kemp Dryer, reactivated every 12 hours (or 22,800 cubic feet of air), has so far required no downtime or service at all! And, according to Mr. Glendon L. Smith, Unit Engineer at Cities Service, there is practically no pressure drop from the entering pressure of 285 pounds . . . further indication of Kemp quality and efficiency.

Kemp Dryers for Every Purpose

Kemp offers a variety of dryer models to meet all problems. Designed to dry air, gases or liquids to sub-zero dew points at low cost, they are constructed of quality materials and embody the engineering knowledge gained from Kemp's many years of experience. They are available with manual, semi-automatic or fully automatic tower reactivation. In addition, Kemp will prescribe the proper desiccant for each specific drying job. If you have a problem involving the removal of water from air, gases or liquids, contact Kemp now. For complete facts and technical information, write for Bulletin No. D-100.

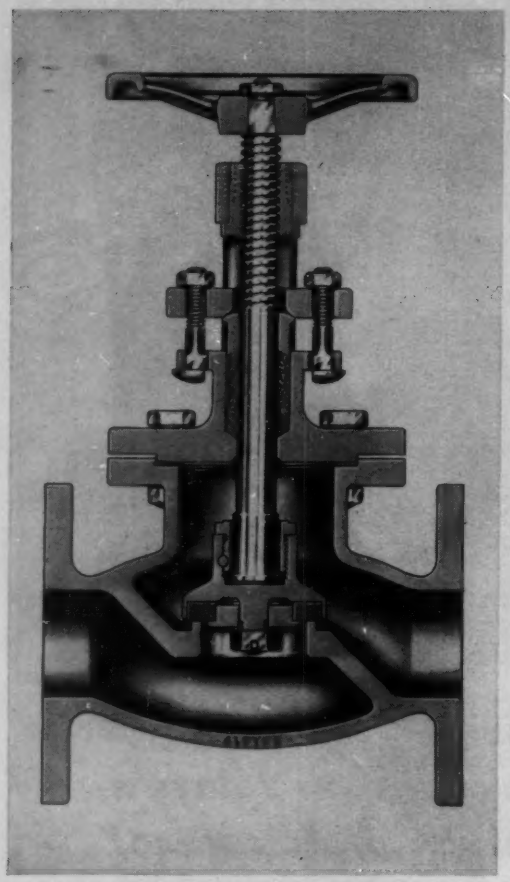
KEMP OF BALTIMORE

DYNAMIC DRYERS

CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • INERT GAS GENERATORS
SINGEING EQUIPMENT

THE C. M. KEMP MFG. CO.
405 East Oliver Street, Baltimore 2, Maryland

Aloyco valves with renewable Teflon discs out-last metal-to-metal seated valves



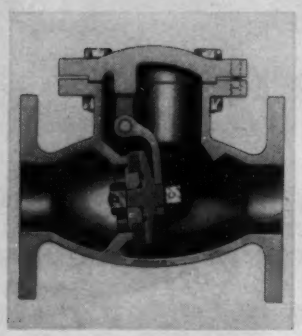
ALOYCO GLOBE VALVE features special holder for renewable Teflon disc to prevent force-out even under heavy overloads.

In handling volatile or elusive fluids, the slightest corrosion of a metal valve seating surface or packing gland is bound to cause leakage.

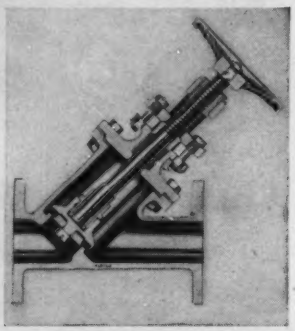
With Teflon discs, however, this leakage is prevented because of Teflon's ability – even when adjoining metal is slightly corroded – to form a gas-tight seal under compression. Add to this the fact that Teflon discs and seats are renewable when worn and you can see why we're using them in so many Aloyco valves.

Teflon, the new DuPont plastic, has outstanding resistance to virtually all corrosive chemicals up to 550° F. It's used as bonnet gasket, packing and seating material in many Aloyco valves specially designed and constructed to take advantage of its remarkable properties.

You can specify Teflon in plain or jacketed, screwed end or flanged Globe, Y, Angle, Swing Check, Needle, Plug Gate or Sampling valves in a variety of alloys and sizes. Send coupon for details.



ALOYCO SWING CHECK VALVE offers greater seat tightness for tighter closing and longer life with renewable Teflon disc.



ALOYCO Y VALVE is easier to maintain and repair, thanks to Teflon disc. Also readies this valve for vacuum service. 5.4

Alloy Steel Products Company, Inc.
1301 West Elizabeth Avenue
Linden, New Jersey

Gentlemen:

I am interested in Aloyco Teflon seated valves. Please send me a free copy of your Bulletin No. 6.

Name_____

Firm_____

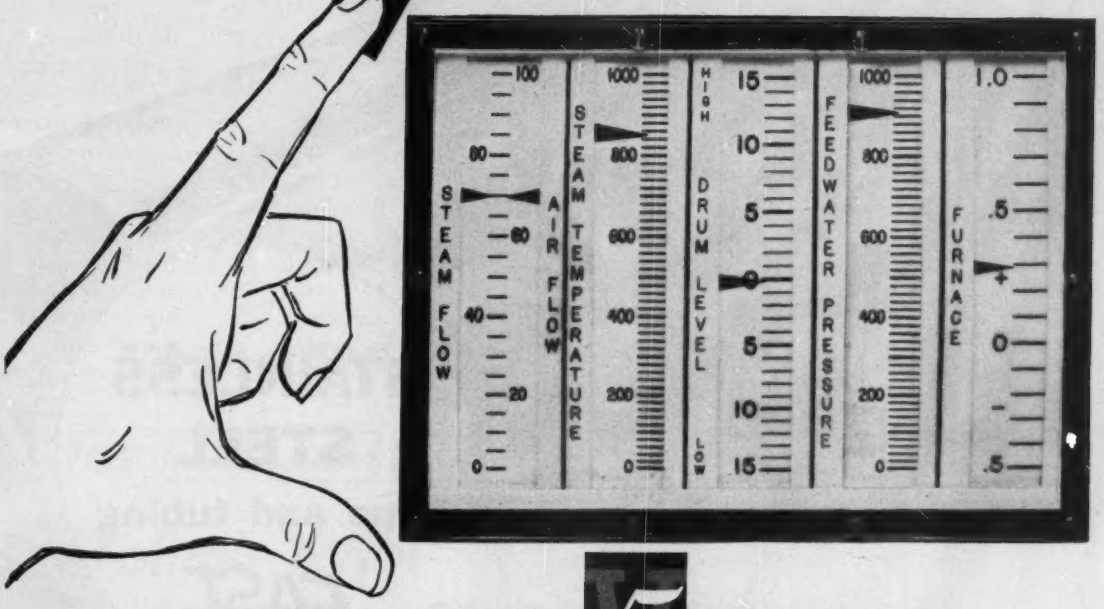
Address_____

City_____ **Zone**_____ **State**_____

Longer Lasting
ALOYCO
VALVES
1ST IN CORROSIVE SERVICE

announcing

a new line of **small-size easy-to-read** gauges and receivers



NEW **REPUBLIC** 5 **GAUGES**

Individual, Independent Measuring Units for
DRAFT • PRESSURE AND VACUUM • DIFFERENTIAL PRESSURE • TEMPERATURE
High Accuracy Receivers for Pnuematic Transmitters and Electric Meters Measuring
FLOW • PRESSURE • CO_2 • DENSITY • LIQUID LEVEL • OTHER PROCESS VARIABLES

Important Features

- FIVE INCH ILLUMINATED SCALES
- INDEPENDENT, INTERCHANGEABLE UNITS
- MULTIPLE OR INDIVIDUAL MOUNTING — from one to eight units to a single case
- EASILY MOUNTED—no panel drilling necessary in most cases
- SCALES EASILY CHANGED OR COLOR-CODED
- POINTER MOTION REVERSIBLE
- SIMPLIFIED CONNECTIONS AT BACK OF CASE
- REMOVAL FROM FRONT OR BACK

Now you don't have to sacrifice instrument performance and readability to size considerations. With Republic's new line of small-size V5 Gauges, you can save panel space, make more compact instrument groupings and *still* get the accuracy, sensitivity and readability you would expect from conventional sized instruments. Full sized diaphragms, bellows and helix units in V5 Gauges assure "big" gauge performance in an instrument that requires only one-fourth the panel space of conventional gauges. Five inch scales are almost flat and are indirectly illuminated as a standard feature for easy reading — even from a distance.

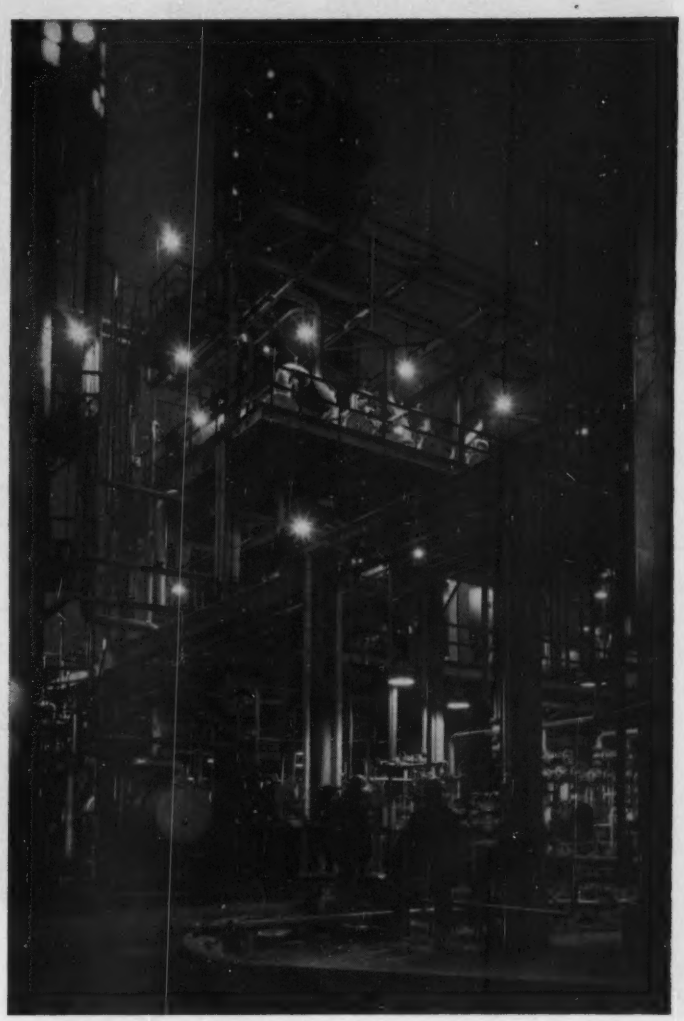
• ***Write for New V5 Bulletin*** ▶

REPUBLIC FLOW METERS CO.
2240 Diversey Pkwy., Chicago 47, Illinois

FAST SERVICE IS CHASE'S SPECIALTY! Not only for brass, copper and bronze, but now for stainless steel, too! Chase Warehouses and Sales Offices stand ready to rush you the type, size and quantity of stainless steel tubing or pipe you need. You get the same kind of dependable service that has made Chase the nation's headquarters for brass and copper. Call Chase *today* for stainless steel.
YOU
CAN GET
STAINLESS STEEL
pipe and tubing
FAST
from
Chase
BRASS & COPPER CO.
WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION
The Nation's Headquarters for Brass & Copper
Atlanta Baltimore Boston Charlotte† Chicago Cincinnati
Cleveland Dallas Denver Detroit Grand Rapids† Houston Indianapolis Kansas City, Mo.
Los Angeles Milwaukee Minneapolis Newark New Orleans
New York Philadelphia Pittsburgh Providence Rochester† St. Louis
San Francisco Seattle Waterbury (†sales office only)

ON-STREAM...DAY AND NIGHT

...to serve your needs for SINCLAIR Toluol, Xylol and Paraxylene



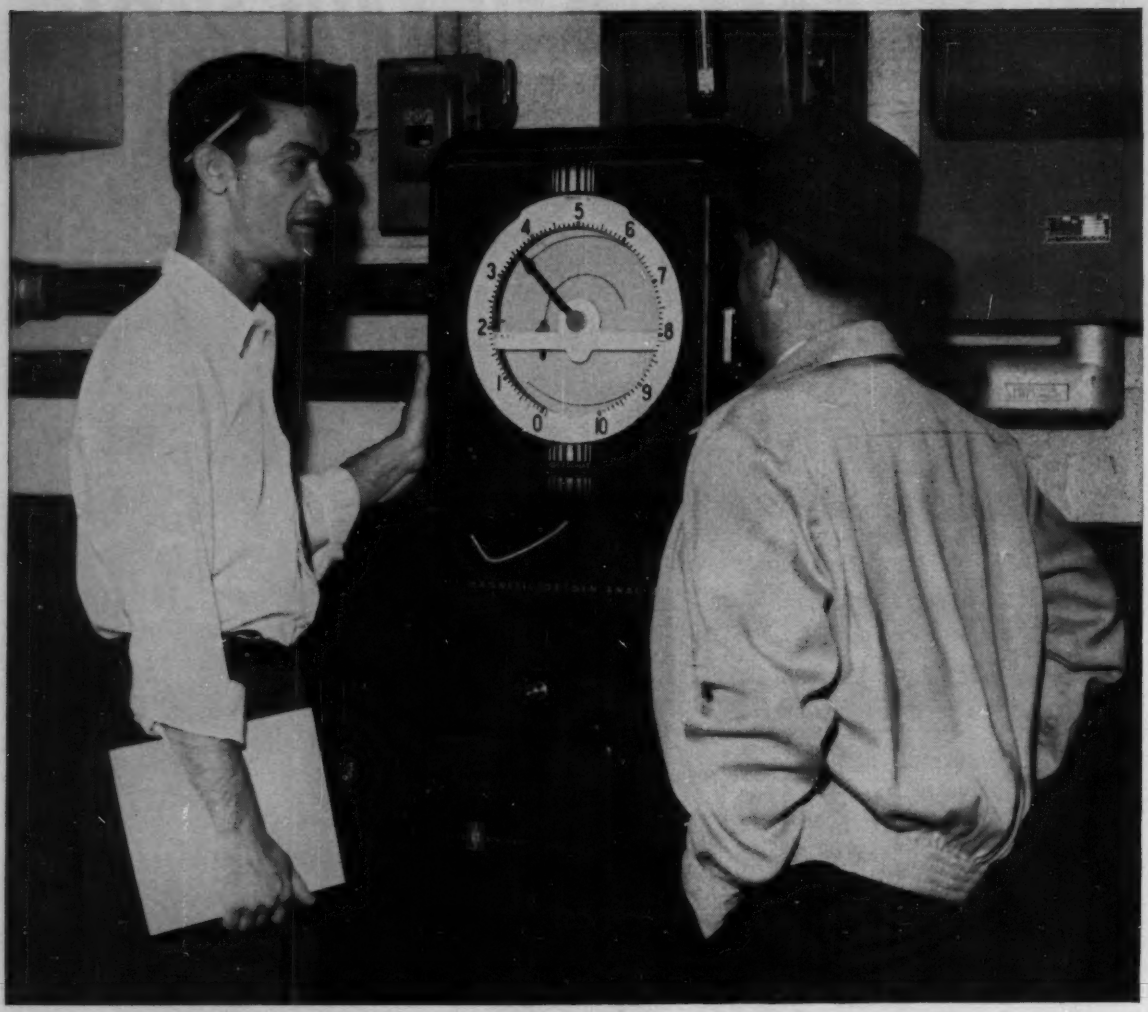
The Udex extraction unit of Sinclair Refining Company at its refinery at Marcus Hook, Pa., operates on-stream 24 hours a day. Toluol, Xylol and Paraxylene produced from this Udex unit meet important industrial needs for high purity petrochemicals in quantity.

When your manufacturing processes call for fast and reliable service and top quality in aromatic hydrocarbons, Sinclair Chemicals, Inc. is ready to serve you. For complete information call or write to:

SINCLAIR CHEMICALS, INC.

(Affiliate of Sinclair Refining Company)

600 Fifth Avenue, New York 20, N. Y. • Phone Circle 6-3600
155 North Wacker Drive, Chicago 6, Illinois • Phone Financial 6-5900



You'll never have to nurse this O_2 Analyzer

What are your most serious complaints about O_2 analyzers? Cumbersome? Slow? Unstable? Hard to service on the job?

You won't find these potential trouble-sources in our new Unitized O_2 Gas Analyzer. They've been literally "designed out" by L&N engineers with experience totaling millions of man-hours in industrial gas analysis.

The Unitized O_2 Analyzer is reduced to the essentials consistent with highly efficient O_2 measurement and control. The entire analysis is made within the 2-component team of O_2 Analyzer Assembly and Speedomax® recorder, eliminating unwieldy auxiliary components such as sample conditioners. Due to its direct magnetic operation, the equipment employs neither auxiliary gas supplies, chemical reactions, nor combustion. Sample and calibration controls are accessible externally, without disturbing the measuring system.

We've introduced sampling innovations, too. The Analyzer gets a sample not only cleaned but purified. A typical sampling lag is 1 sec per 45 ft of ¼" tubing, up to several hundred feet.

The Unitized O_2 Analyzer can help to streamline O_2-dependent processes. For pertinent details of this O_2 monitor, write to 4916 Stenton Ave., Phila. 44, Pa., for Folder ND46-91(5).

PERFORMANCE

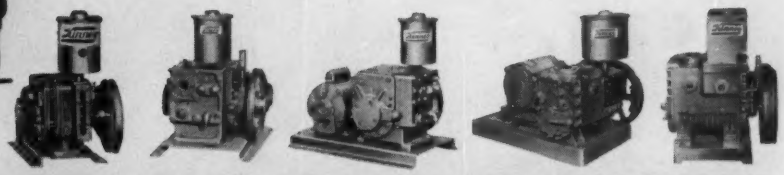
Range	*0 to 5% O_2, 0 to 10% O_2, or higher in flue gas or N_2 as specified.*
Accuracy	*0.15% O_2*
Sensitivity	*Better than ±0.05% O_2*
Stability	*Better than ±0.15% O_2*
Response	*4 sec for initial response; 40 sec for 90% response.*

LEEDS instruments LN NORTHRUP automatic controls • furnaces

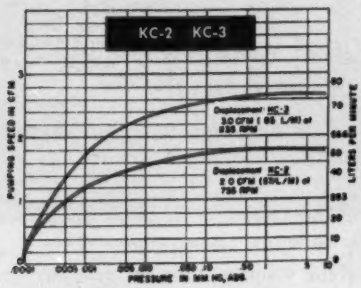
Jrl. Ad ND46-91(5)

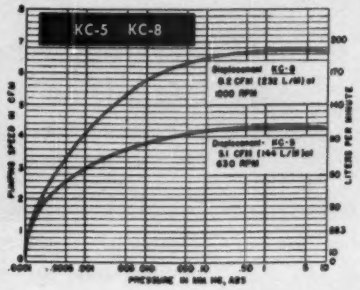
The facts speak for themselves! We rest our case!!

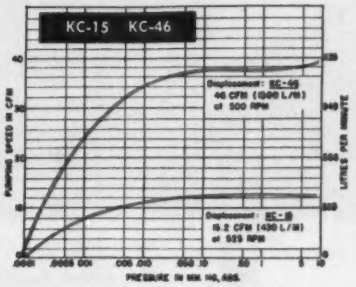
KINNEY COMPOUND HIGH VACUUM PUMPS



SPECIFICATIONS	MODEL KC-2	MODEL KC-3	MODEL KC-5	MODEL KC-8	MODEL KC-15	MODEL KC-46
Free Air Displacement	2.0 CFM	3.0 CFM	5.1 CFM	8.2 CFM	15.2 CFM	46.0 CFM
Free Air Displacement	56.5 Liters/min.	85.0 Liters/min.	144. Liters/min.	232. Liters/min.	430 Liters/min.	1300 Liters/min.
Free Air Displacement	.95 Liters/sec.	1.41 Liters/sec.	2.4 Liters/sec.	3.9 Liters/sec.	7.2 Liters/sec.	21.7 Liters/sec.
RPM	755	1135	630	1000	525	500
Motor H.P.	¼	½	⅓	½	1	3
Motor RPM (syn.)	1800	1800	1800	1800	1800	1800
Oil Capacity	6 oz.	6 oz.	1⅓ pt.	1⅓ pt.	2 qt.	1 gal.
Shaft Diam.	¾"	¾"	¾"	¾"	¾"	1⅛"
Inlet Connection	¾" Screwed	¾" Screwed	1" Screwed	1" Screwed	2" Screwed	3" Screwed
Outlet Connection	None	¾" Screwed	1" Screwed	1" Screwed	1¼" Screwed	1½" Screwed
Net Weight, Complete	70 lb.	78 lb.	140 lb.	148 lb.	300 lb.	585 lb.







SUMMATION

- Reliable High Vacuum (Cam and piston displacement)
- Rapid Recovery of Vacuum
- Simple to Maintain
- Dynamically Balanced
- Standard Small Motors
- Gas Ballasted (optional)
- Economical
- Dependable
- Small, Compact Design

VERDICT

Your verdict will be FAVORABLE when you review all the facts. Request Bulletin 403 for additional data or contact one of our competently staffed district offices in Baltimore, Chicago (LaGrange), Cleveland, Los Angeles, New York, Philadelphia, San Francisco, or St. Louis.

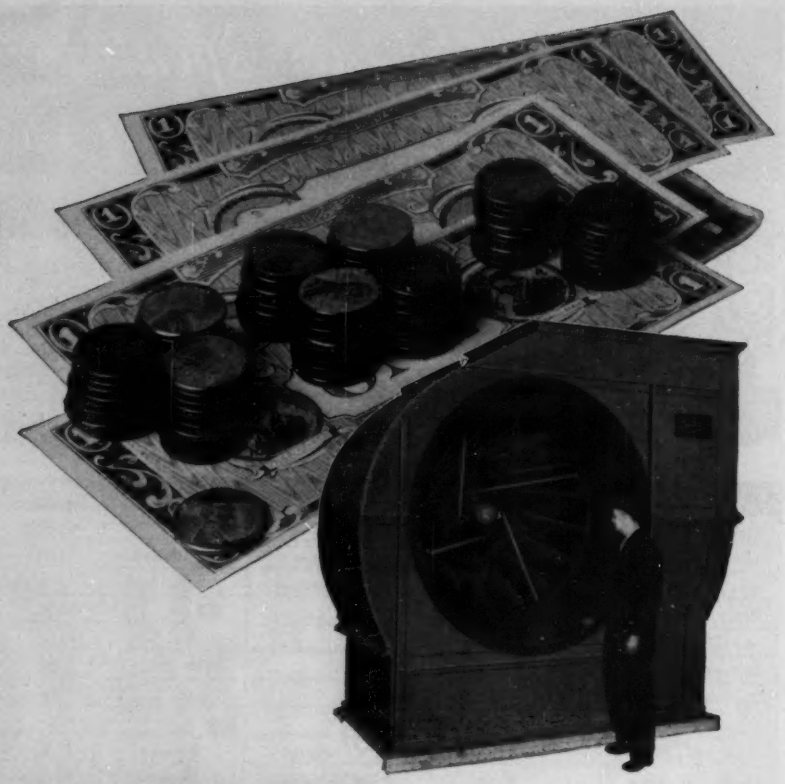
write today

KINNEY MFG. DIVISION
THE NEW YORK AIR BRAKE COMPANY
3551 WASHINGTON STREET • BOSTON 30 • MASS.
INTERNATIONAL SALES OFFICE, 90 WEST ST., NEW YORK 6, N.Y.

• PLEASE SEND BULLETIN 403 giving complete data on Kinney Compound Pumps
Our vacuum problem involves.....

Name.....
Company.....
Street.....
City.....State.....

$AVE UP TO 91c *of every* $1.



INVESTED IN CORROSIVE FUME HANDLING

SEE HOW "BUFFALO" RUBBER-LINED EXHAUSTERS ARE DOING IT IN HUNDREDS OF PLANTS

Fumes from many processes destroy ordinary steel plate exhausters far earlier than normal life expectancy — and fan replacement is a major expense.

"Buffalo" Rubber-Lined Fans save you this expense. All exposed parts are protected by a layer of rubber "welded" permanently to the steel. *Corrosive fumes cannot contact the metal.* Small wonder these fans have stood up under the severest fume services anywhere from 3 to 12 times longer! Savings far more than pay for the cost of the rubber lining, to say nothing of reduction in down-time. It's just one more example of the "Q" Factor* that saves you money in all "Buffalo" Fans.

If you have fume exhausting installations, it will pay you to check fan replacement and down-time costs, and see how "Buffalo" Rubber-Lined Exhausters could be saving you money.

WRITE FOR BULLETIN 2424-F TODAY!

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

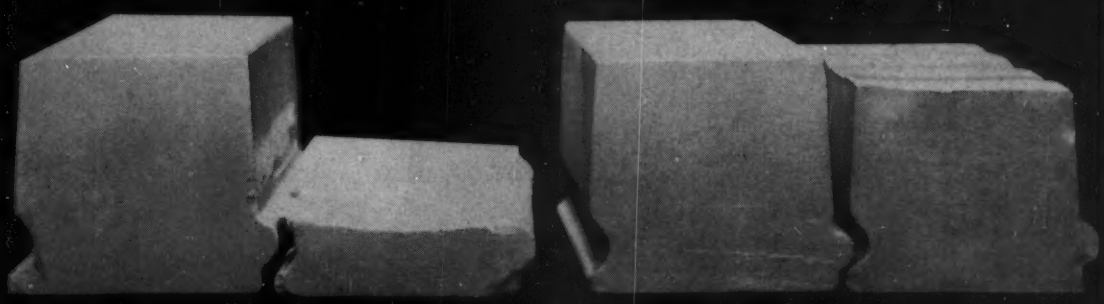
BUFFALO FORGE COMPANY
BUFFALO, NEW YORK
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Here's proof

ALCOA® Alumina doubles – even triples – the life of ceramic mill liners



BEFORE TEST AFTER TEST

Standard porcelain block

BEFORE TEST AFTER TEST

Arlcite block containing ALCOA ALUMINA

▼ **The first and third blocks from the left, shown above, were used to line a mill in which accelerated grinding tests were conducted. The same blocks, after test, are beside the originals. Note how abrasive action in grinding has seriously worn away the standard porcelain, yet has had little effect on the Arlcite block. Arlcite, manufactured by The Patterson Foundry & Machine Company, East Liverpool, Ohio, is a high density ceramic, the principal ingredient of which is ALCOA Alumina.**

As the pioneer commercial producer of high density mill linings, lifter bars and grinding media, Patterson recognized the value of ALCOA Alumina in ceramics when production was started in 1938. Its extraordinary toughness and abrasion resistance made it a natural choice for Arlcite.

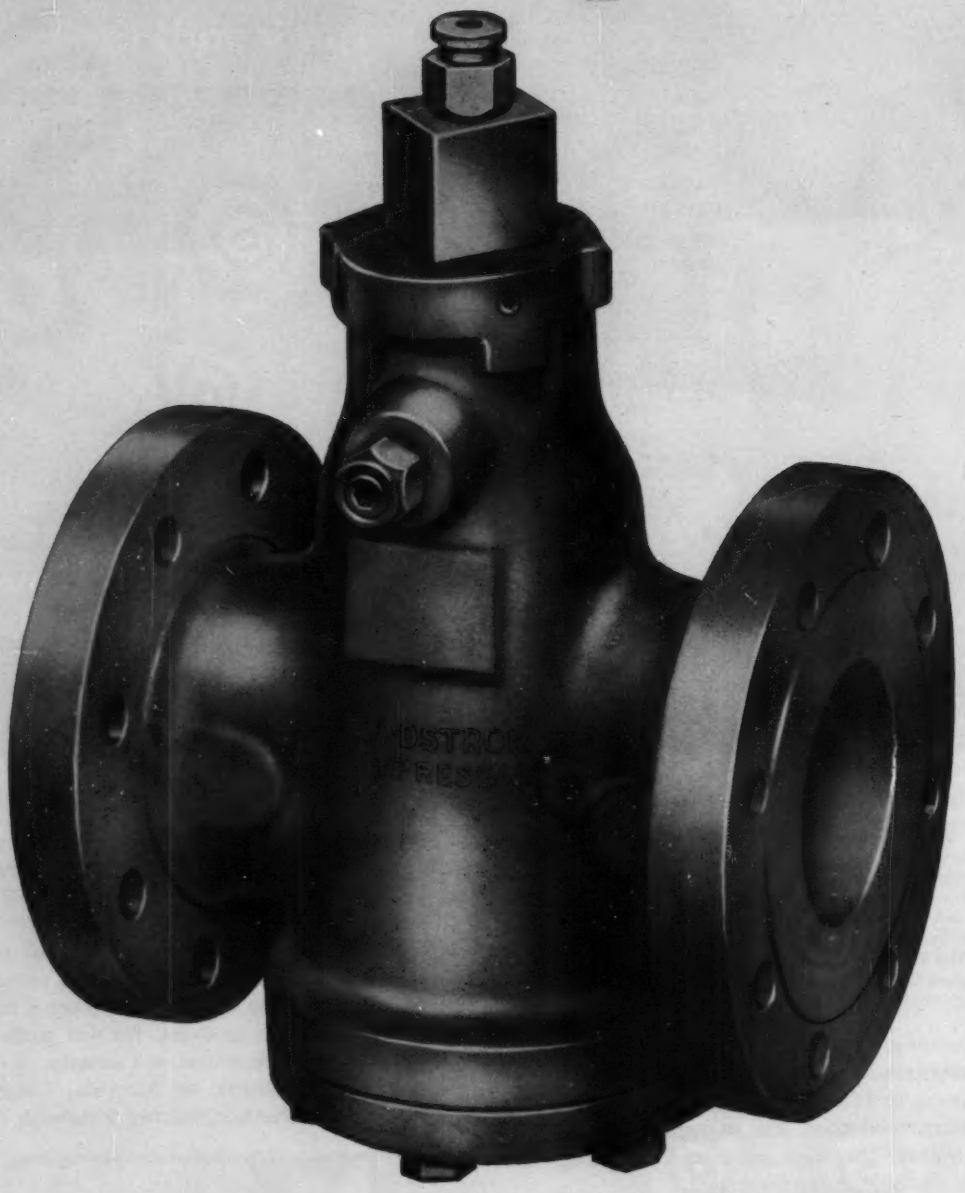
Arlcite high-alumina ceramic will outwear porcelain linings 2½ to 3 times, thus reducing contamination of product, frequent relinings and costly downtime. Moreover, grinding tests conducted with extra-abrasive vitreous enamel showed a reduction in grinding time of 40 to 60 per cent, with negligible losses in mill linings and grinding media. This resistance to abrasion and impact has prompted Patterson to develop disintegrator blades and other new products with ALCOA Alumina.

ALCOA does not make ceramic products. But more and more leading manufacturers are adding ALCOA Alumina to their mixes to improve the performance of their products. We will gladly send you complete information and samples. Write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 702-E Alcoa Building, Pittsburgh 19, Pa.

ALCOA CHEMICALS
ALUMINUM COMPANY OF AMERICA

ROCKWELL-

Often Copied...



40th YEAR *of*

Nordstrom VALVES

Never Equaled

Rockwell-Nordstrom is the *original* lubricated plug valve. But that is only part of the story behind forty years of lubricated plug valve leadership. Starting with the first valve, *every major development* in lubricated plug valves has come to you *first* in a Rockwell-Nordstrom valve. Today, as always, the *oldest* lubricated plug valve is also the *newest* in terms of better performance, longer life and lower cost.

Below are listed only a few of the more than ninety basic Rockwell-Nordstrom valve and lubricant innovations. They are the reasons why Rockwell-Nordstrom valves—although often copied—have *never* been equaled. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Canadian Valve Licensee: Peacock Brothers Limited

ROCKWELL-Nordstrom VALVES

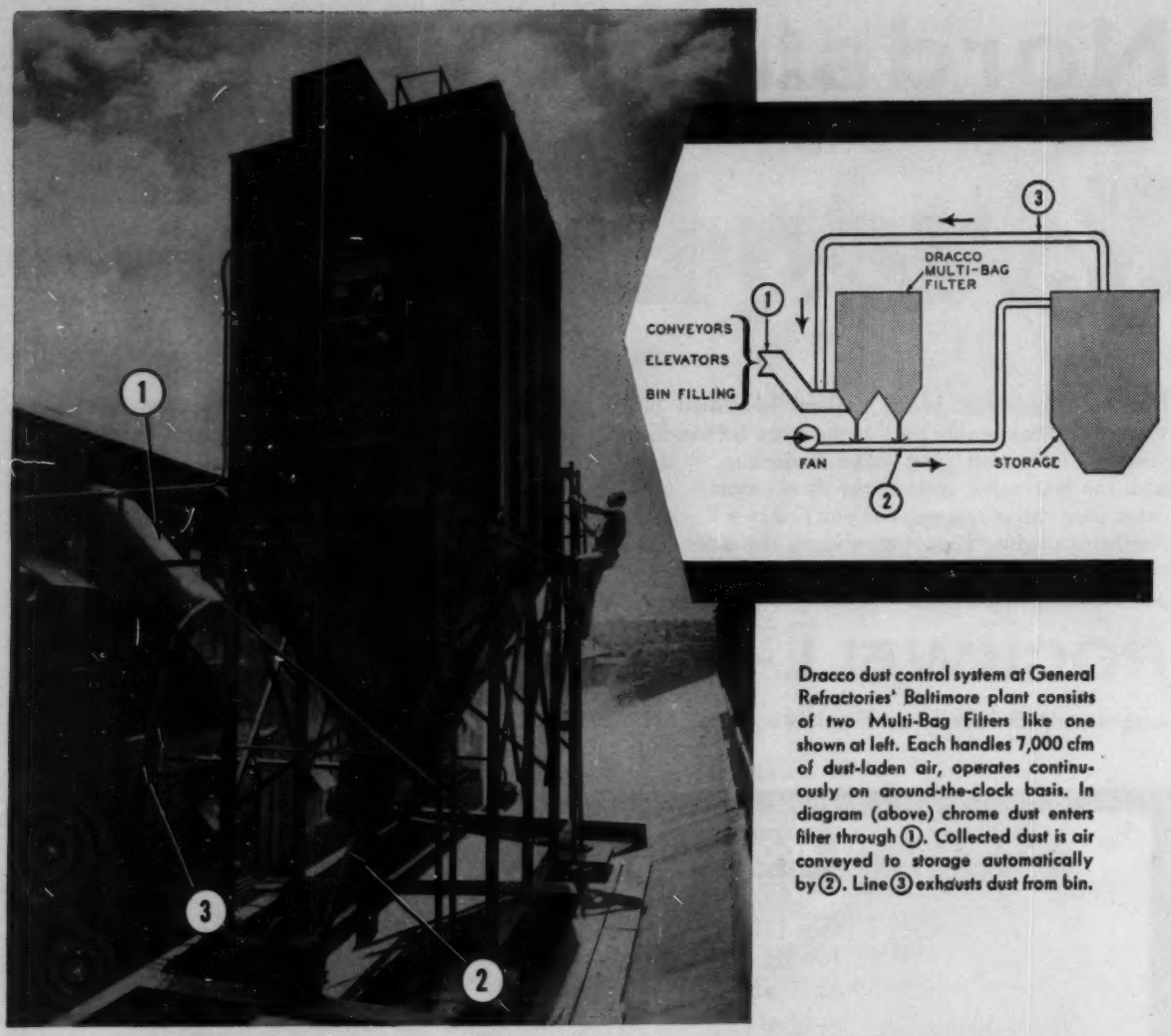
Lubricant Sealed for Positive Shut-off

first... for forty years *Here are just a few of more than ninety basic valve and lubricant innovations that have maintained the leadership of Rockwell-Nordstrom valves—through better performance, longer life and lower cost.*

- **FIRST Lubricated Plug Valve**
- **FIRST Sealdport* pressurized lubricant sealing**
- **FIRST Hydraulic plug jacking for fast, dependable operation**
- **FIRST Hypreseal* for high pressure plug valve service (still exclusive)**
- **FIRST Special plug and body coatings—longer life on "tough" services**
- **FIRST Automatic shut-off valves for gas pipelines**
- **FIRST "Self-Energizing" valve lubricants**
- **FIRST Line of special and general purpose valve lubricants**
- **FIRST Multiport lubricated plug valves for 3-way and 4-way flow control**
- **FIRST Lubricated plug valve for low temperature service**
- **FIRST Venturi valve for lower cost on larger lines**
- **FIRST Lubricated plug Christmas tree valves**

*Registered trade mark Rockwell Manufacturing Company

lubricated plug valve leadership



Dracco dust control system at General Refractories' Baltimore plant consists of two Multi-Bag Filters like one shown at left. Each handles 7,000 cfm of dust-laden air, operates continuously on around-the-clock basis. In diagram (above) chrome dust enters filter through ①. Collected dust is air conveyed to storage automatically by ②. Line ③ exhausts dust from bin.

How to Solve a Dust Problem - *Completely*

When you try to expand the production facilities of the world's largest basic refractories plant (General Refractories Company at Baltimore), you are faced with a serious problem. This is the escape of chrome dust from materials handling and bin filling operations. What would you do?

General Refractories and Dracco engineers coordinated their abilities to provide an outstanding Dracco dust control installation which is the complete and final answer to this annoying and costly problem.

Chrome dust is now trapped at its source before it can spread, moved through an enclosed system and collected in two peak-efficiency Multi-Bag Filters. This produces better plant efficiency, improved working conditions with reduced health hazards, no threat of costly abrasive wear of machinery, and minimum housekeeping costs.

An added cost-saving feature of the Dracco system is that all recovered dust is returned directly to process bins by fan-type Airstream Conveyors for reuse. By eliminating manual handling, savings in labor costs are realized. Because of the success of this operation, Airstream Conveyors have been added to two dust filters previously installed to move dust back to process.

If you want to solve your dust problem completely, follow General Refractories' example—call in Dracco. You'll be glad you did.

DRACCO CORPORATION

4040 East 116th Street • Cleveland 5, Ohio

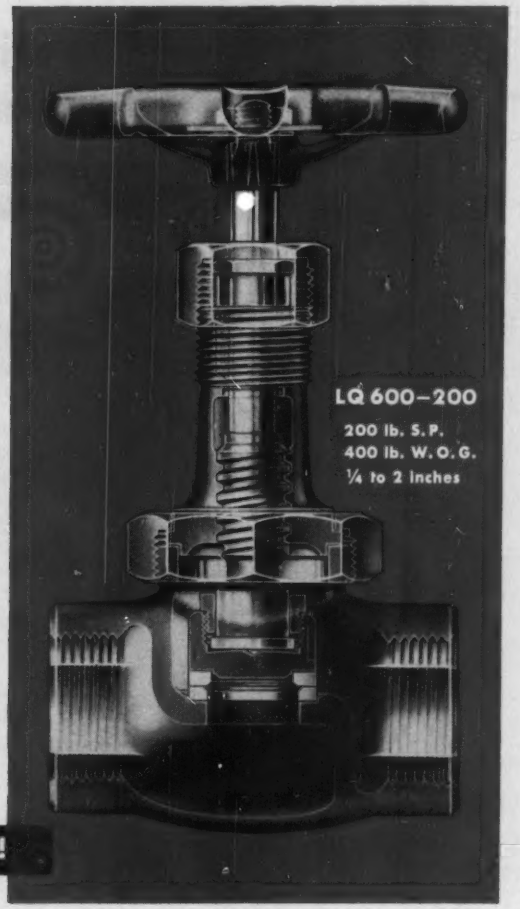
FREE! THE DRACCO ENGINEER. Describes Dracco solutions to many bulk materials handling and dust control problems—includes tips on improving plant efficiency . . . published quarterly. Get on the mailing list. Write on your letterhead today!

DRACCO *Performance Proved*

Airstream CONVEYORS · DUST CONTROL EQUIPMENT

Lunkenheimer Announces

ANOTHER GREAT NEW LQ600 VALVE



200 Lb. S.P.! 400 Lb. W.O.G.!

Lunkenheimer's famous LQ600, the Bronze Globe Valve that set a new high standard of performance on 150 lb. service, is now available for 200 lb. S.P., 400 lb. W.O.G. applications. The new line features the same long-wearing flat seats and discs made of Brinalloy®, plus a body and bonnet of Lunkenheimer's amazingly strong S-1 Bronze for higher-pressure service. Install this great new LQ600 Valve on your 200-lb. pressure lines—including all your toughest services—and compare its performance with other valves. It's built to eliminate maintenance costs because there is no replacement of seats and discs—they are patented Brinalloy, brazed in to stay, harder all the way through and more resistant to wear and corrosion than 500 Brinell Stainless Steel and far exceeding the wear resistance of 1000 Brinell case-hardened Stainless Steel.

LUNKENHEIMER QUALITY

Now there are *TWO* LQ 600 Valve Lines

The original LQ600 Valve for 150 lb. S.P., 300 lb. W.O.G. service has received the fastest acceptance of any valve introduced in years. Thousands of these valves are in service—some as long as five years—without a single reported case of failure or leakage.

FOR COMPLETE INFORMATION WRITE.... The Lunkenheimer Company, Box 360, Cincinnati 14, Ohio, or get in touch with your Lunkenheimer Distributor.

BRONZE • IRON • STEEL • PVC

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

L-256-27

Purifies and concentrates Bulk Chemicals where other methods fail

STEARNS HIGH-INTENSITY MAGNETIC SEPARATOR

Stearns Type K magnetic separator provides an intensely powerful magnetic field which attracts very feebly magnetic particles. That is why the "K" has proved highly successful in purifying and concentrating chemical products when other methods were either impractical or inadequate.

Users report that this separator has given outstanding results for magnetically cleaning or concentrating materials ranging in size from 10 to 200 mesh. Capacity ranges from 80 to over 500 lb per hr per inch of feed width. "K" separators are built in 10, 20 and 30-in. feed widths and can be furnished with from 2 to 7 magnetic fields. Complete laboratory facilities available for testing samples of your product. We invite comparison of results. Write today for bulletin 701B.

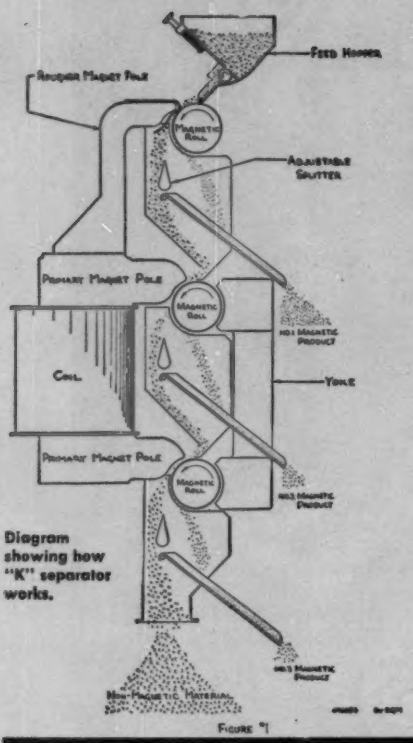
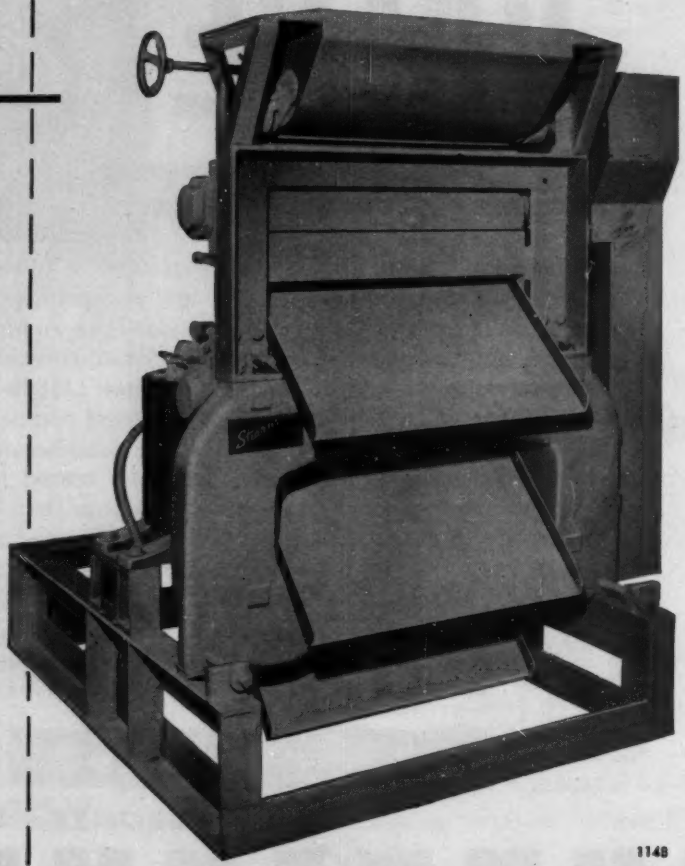


Diagram showing how "K" separator works.



1148

FEATURES THAT PUT THE "K" OUT FRONT:

1. Magnetic field protected against flux leakage
Magnet support frame is not part of magnetic circuit. Specially constructed steel rolls with non-magnetic stub shafts further insulate magnetic circuit.

2. Simple adjustment
Positive, easy control of feed rate, air gap width, splitter settings for extremely accurate separation. So simple, unskilled workers can operate and adjust it.

3. Uniform material distribution
Louver-type feeder provides uniform distribution across entire feeder width. Speed of feed closely matches roller speed for greatest efficiency.

4. Powerful magnetic force
Primary pole noses are scientifically shaped to give maximum flux density in separating zone—take full advantage of powerful electro-magnetic force.

5. Dependable, long-lasting
Triple-sealed bearings keep out dust, insure smooth, low-cost operation. All parts are easily accessible for service.

Here are some products the "K" handled profitably:

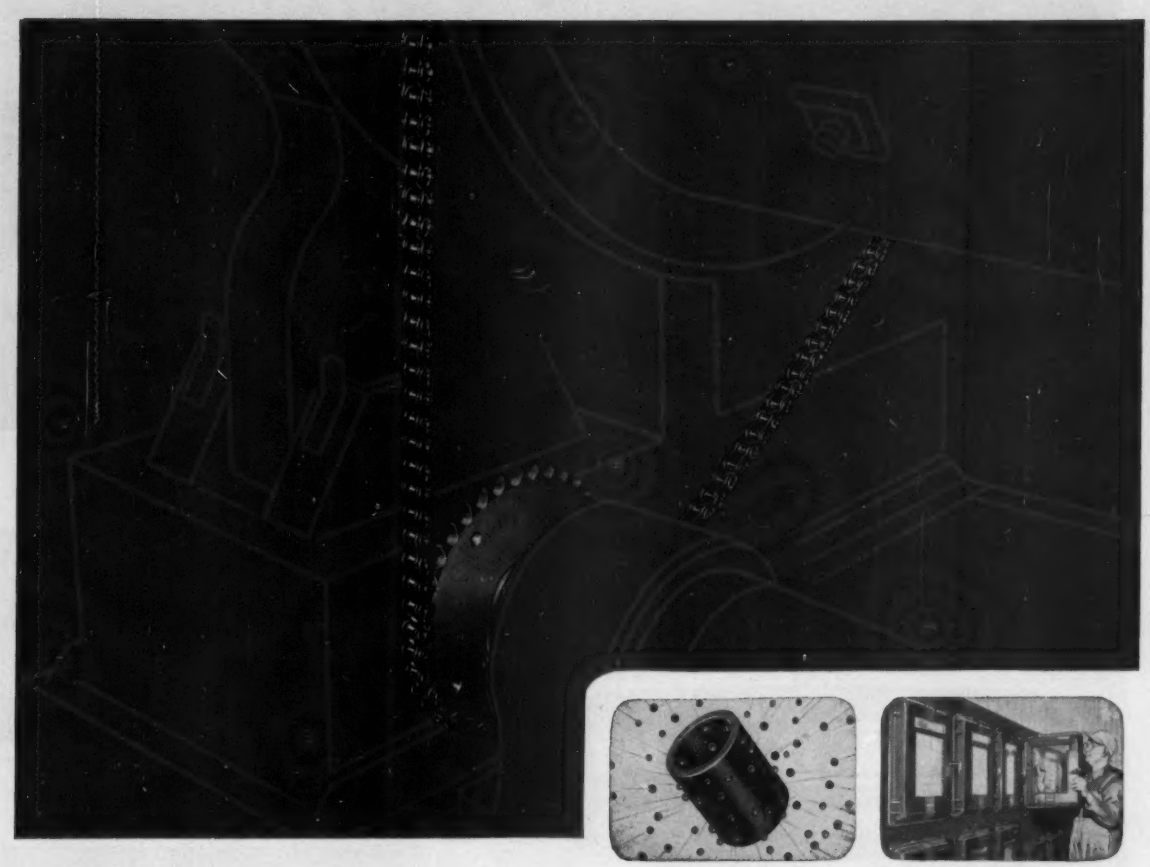
Silica Sand	Feldspar
Scheelite	Nepheline Syenite
Soda Ash	Dolomite
Silicon Carbide	Bauxite
Aluminum Oxide	Magnesite
Fire Clay	Sodium Sulphate
Kyanite	Fluorspar
Phosphate & Derivatives	Sodium Sesquicarbonate
Borax	Sodium Carbonate

MAGNETIC EQUIPMENT FOR ALL INDUSTRY

STEARNS MAGNETS

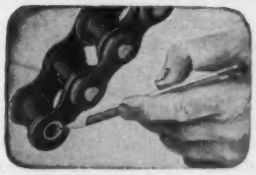
STEARNS MAGNETIC, INC., 629 S. 28th St., Milwaukee 46, Wis.

How these EXTRAS* make roller chain last longer

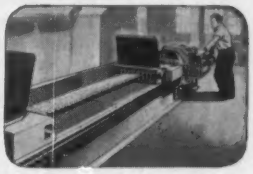


SHOT-PEENED ROLLERS have greater fatigue life, added ability to withstand impact.

CLOSER HEAT-TREAT CONTROL — coupled with rigid testing insures uniformity.



LOCK-TYPE BUSHINGS (applied on a range of sizes) end a cause of stiff chain.



PRE-STRESSING of multiple width chain provides uniform load distribution.

*And you pay no premium for these LINK-BELT extras

THERE's more to roller chain than just the parts you see. *Much more!* It's the hidden extras—standard on Link-Belt Precision Steel Roller Chain—that add up to longer life and lower costs.

Check the four extras shown here. Then for your demanding drive and conveying jobs, choose from the complete line of Link-Belt roller chains and sprockets: Single or multiple widths, ¼″ through 3″ pitch. Double pitch, 1″ through 3″. There's full ordering and application information in 148-page Data Book 2457. Ask your Link-Belt office or distributor for a copy today.

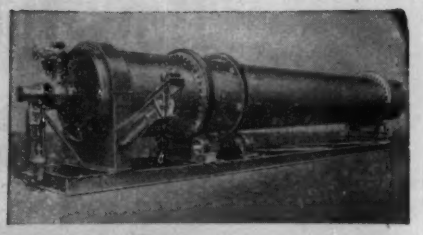
LINK-BELT

ROLLER CHAIN & SPROCKETS

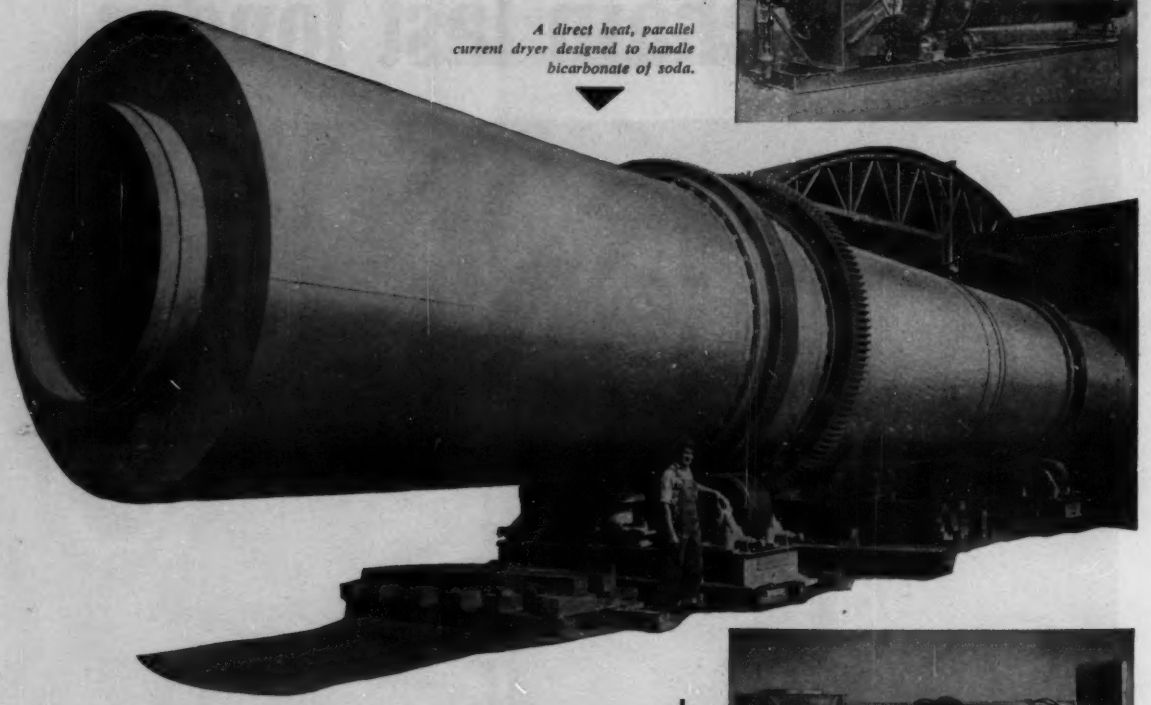
13.000

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

Steam tube dryer. Enables continuous operation at uniform temperature, producing an extremely uniform product.



A direct heat, parallel current dryer designed to handle bicarbonate of soda.

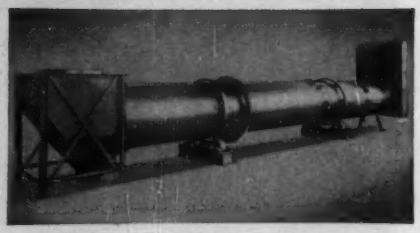


"LOW OPERATING COST" WITH

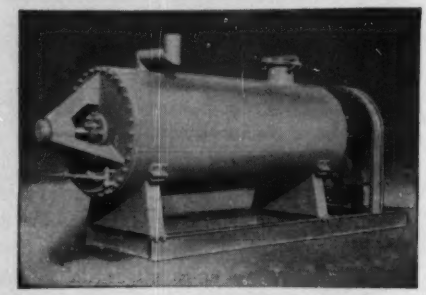
STANDARD HERSEY DRYERS

Presque Isle Starch Company of Maine reports potato starch drying production doubled... Huron Milling Company of Michigan reports one STANDARD-HERSEY dryer replaces 16 pairs of hot rolls... Stansbury Salt Company of Utah reports high efficiency at very low operating cost... Warriner Products Company of Louisiana reports *very satisfactory* operation in dehydrating sweet potatoes.

Hundreds of similar comments add up to one thing—STANDARD-HERSEY dryers are cutting costs and increasing production in many phases of the food field. We have, or can find, a solution to *your* drying problem. More than 30 different types of STANDARD-HERSEY dryers are available. Over 4,000 dryers have been built for hundreds of product applications. Investigate STANDARD-HERSEY for the answer to your drying problems.



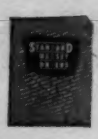
Intermediate feed type starch dryer. Dries product from 40% to 18% with hourly output of 1,500 lbs. Extra high thermal efficiency because of no boiler loss.



Steam jacketed batch type. May be used as either a dryer or cooker—operated under pressure or vacuum. Available with alloy or stainless interior.

SEND FOR FREE 12-PAGE ILLUSTRATED BULLETIN

Learn how STANDARD-HERSEY has aided manufacturers throughout the world in solving their dryer problems.



COMPLETE PILOT PLANT TAKES GUESSWORK OUT OF DRYING

STANDARD-HERSEY'S pilot dryers play an important part in solving your drying problems *before* blueprint stage.

THE STANDARD FOR 52 YEARS

STANDARD STEEL CORPORATION

5005 BOYLE AVE., LOS ANGELES 58 • 7 EAST 42ND ST., N. Y. 5

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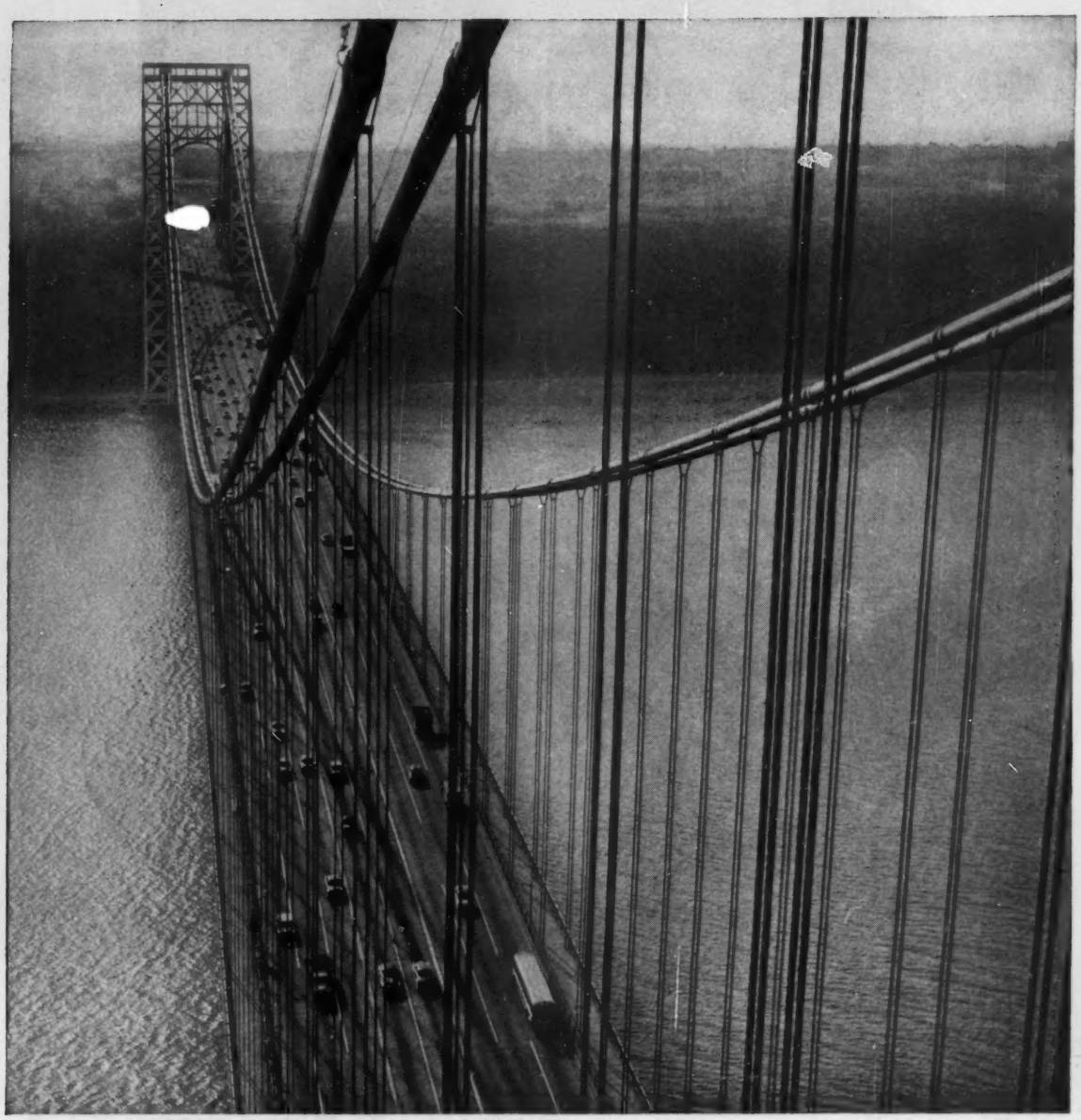


GEORGE WASHINGTON BRIDGE, most traveled suspension bridge in the world, was opened to traffic in 1931 and now serves over 30 million vehicles annually.

KNOW-HOW THAT SPANS THE FIELD!

Now entering its second quarter century of service, the mighty George Washington Bridge is a prime example of the dependable performance that great skill and experience can achieve. In the industrial field, Esso Petroleum Solvents offer the same reliable performance achieved through high technical skill and constant maintenance of quality. Because Esso Petroleum Solvents must meet rigid quality standards, they combine highest product character with complete dependability. For detailed information or technical assistance, write or call: Esso Standard Oil Company, Solvents Division, 15 W. 51st Street, New York 19, N. Y.

ESSO

PETROLEUM SOLVENTS

RESEARCH AND EXPERIENCE DEVELOPED THE FINE CHARACTER OF ESSO SOLVENTS

This is Why the Nash is the Most Simple Compressor

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

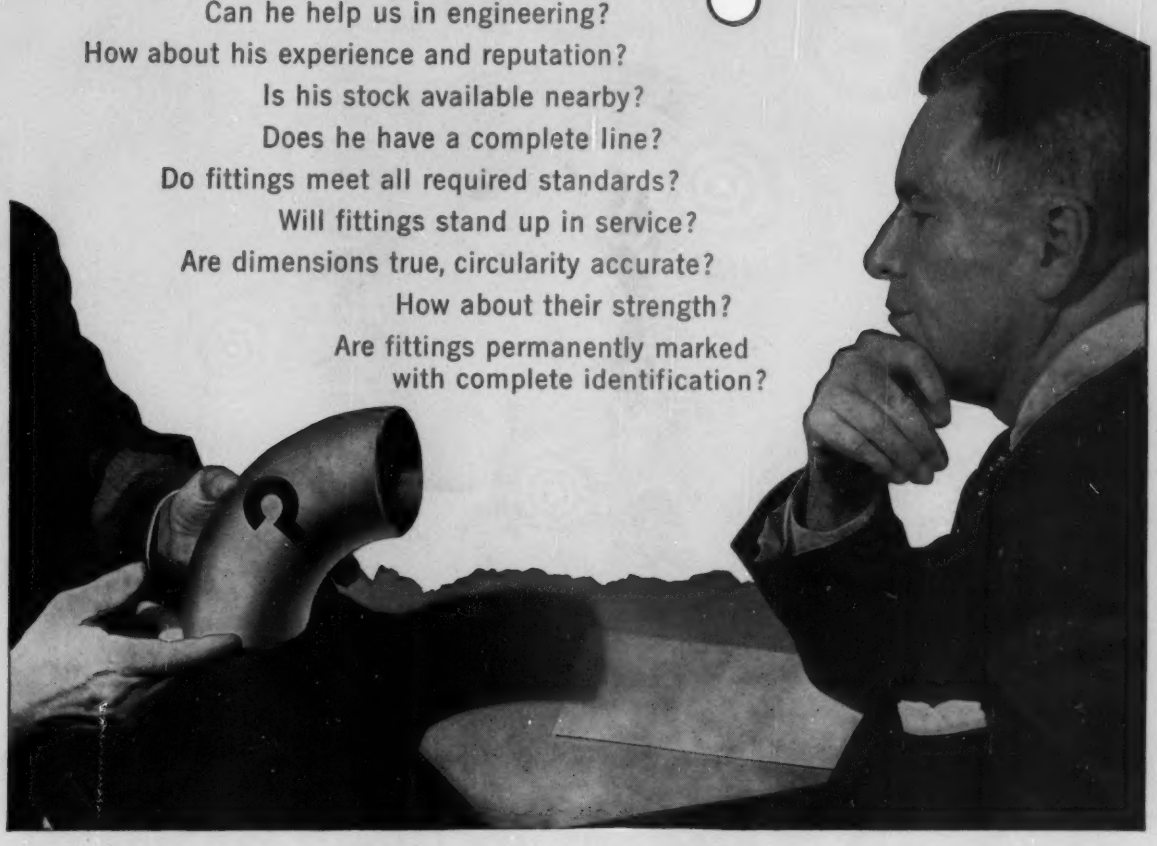
Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

NASH ENGINEERING COMPANY
315 WILSON, SO. NORWALK, CONN.

why run a risk with Question-Mark fittings

Is the manufacturer a piping specialist?
Can he help us in engineering?
How about his experience and reputation?
Is his stock available nearby?
Does he have a complete line?
Do fittings meet all required standards?
Will fittings stand up in service?
Are dimensions true, circularity accurate?
How about their strength?
Are fittings permanently marked with complete identification?



No unanswered question...no risk
when you buy known fittings

YOU SAVE purchasing time and avoid trouble later on when you buy TUBE-TURN* Welding Fittings and Flanges. Made in U.S.A. by the leader in the field, these products give you top quality and uniformity, backed by unmatched engineering service and nearby complete-line distributor facilities. They meet *all* American Standard and Safety Code requirements. Each product is permanently identified by the "TUBE-TURN" trademark with complete size and material designation. You can't get a better bargain in welding fittings and flanges than from your trusted Tube Turns' Distributor!

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Detroit • Chicago • Kansas City • Denver
Los Angeles • San Francisco • Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas

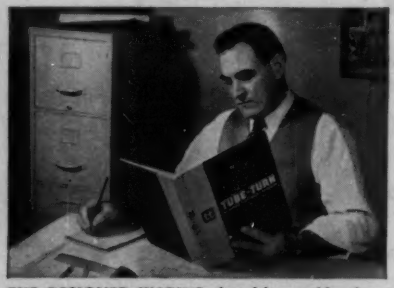
*"TUBE-TURN" and "TT" Reg. U.S. Pat. Off.

POSITIVE IDENTIFICATION

THE WELDER KNOWS he's getting the exact fitting specified on the blueprint because the fitting is clearly marked with all designations.

Complete...Permanent Identification!

THE STOREROOM WORKER KNOWS he is selecting the right fitting when it's marked "TUBE-TURN". The fitting bears complete information called for on the requisition.



THE DESIGNER KNOWS that his specifications will be carried out precisely where his drawings call for "TUBE-TURN products". At every stage . . . from purchasing to pipe installation, people KNOW what they're getting and using.

CLEARLY MARKED. TUBE-TURN* Welding Fittings are completely identified as to dimensional and metallurgical facts. Here is your assurance that you have the RIGHT fitting, and that it has passed Tube Turns' rigid inspection and quality control.

This is just *one* reason why you should specify the leading brand of fittings and buy from your trusted Tube Turns' Distributor.

TUBE-TURN Welding Fittings and Flanges are made in U. S. A.
They meet *all* U. S. piping code specifications.

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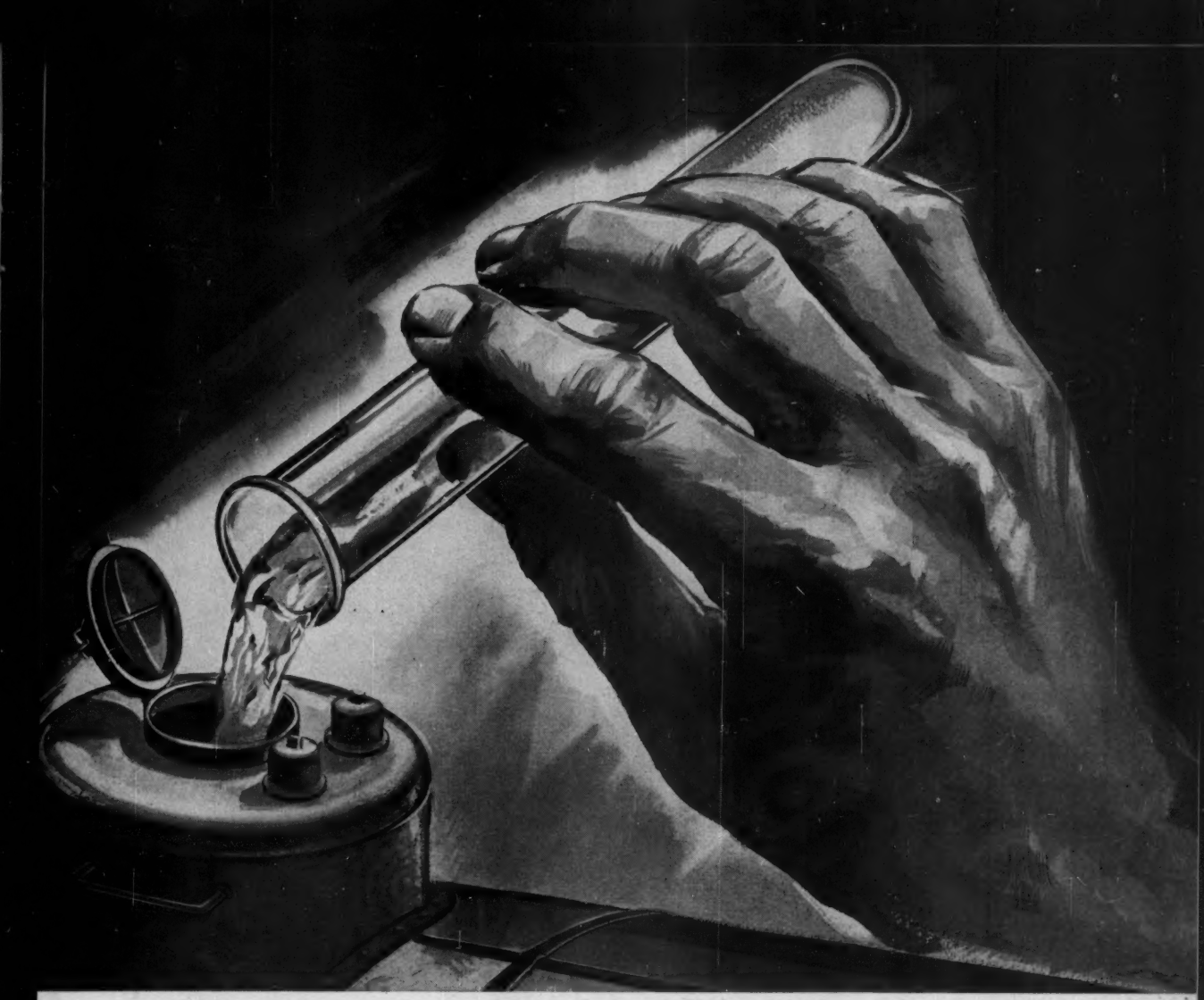


CELANESE* VINYL PROPIONATE MONOMER

goes "tankcar!"

Full scale production of new monomer provides new source for homopolymers and copolymers with distinctive product-improving properties

Celanese Vinyl Propionate Monomer in volume clears the way for the commercial development of new emulsion paints, adhesives, laminates, plastics, synthetic rubbers, protective coatings and finishes.

Like Vinyl Acetate—first of the Celanese Vinyl Monomers—Vinyl Propionate copolymerizes with acrylics, maleics, styrene, butadiene, and most other vinyl monomers. It promises new product values for many fields.

You can get prompt delivery of Celanese Vinyl Propionate in drum lots to tankcar quantities. For samples and technical bulletin, write:

Celanese Corporation of America, Chemical Division, Dept. 553-E, 180 Madison Avenue, New York 16.

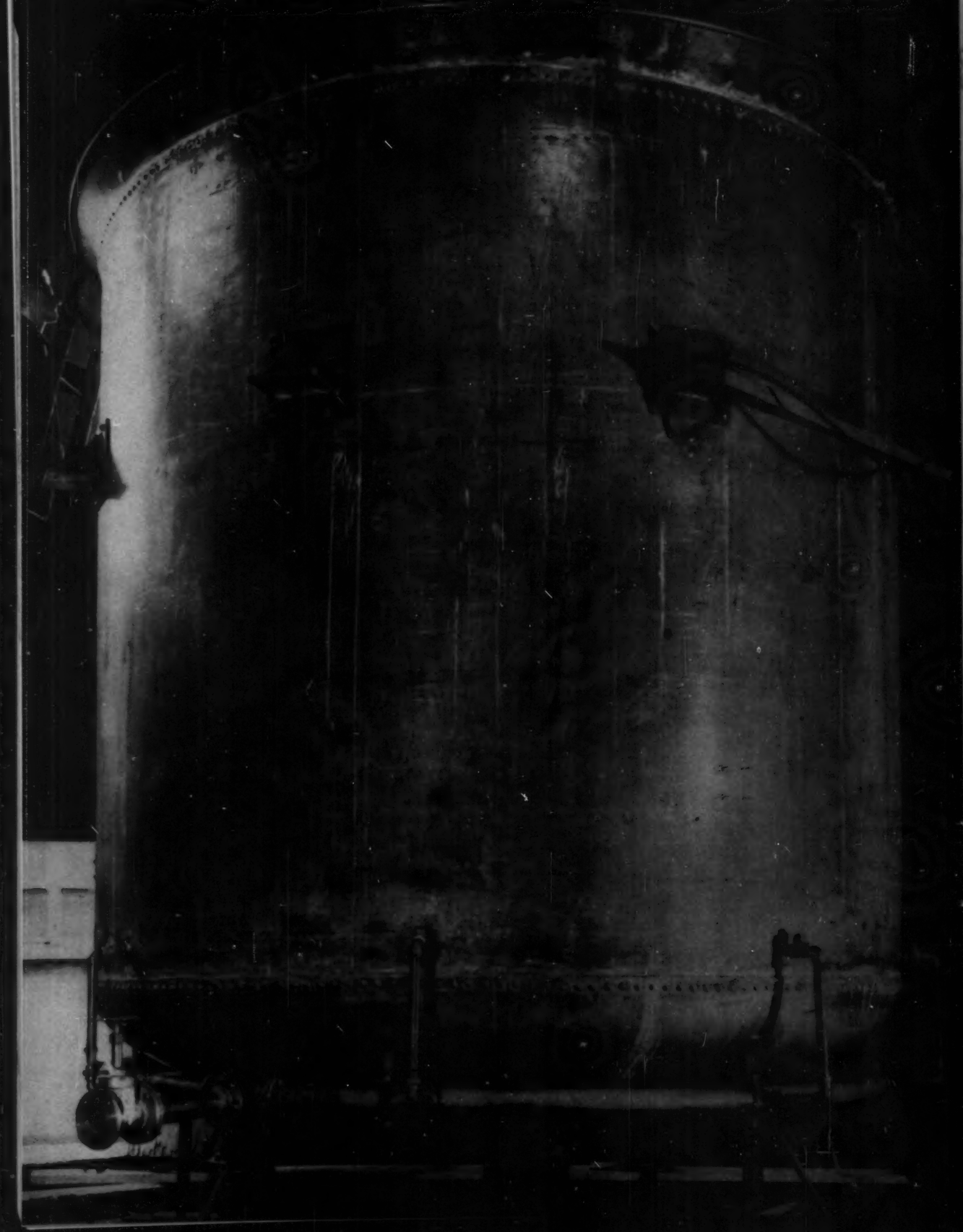
DESCRIPTIVE DATA

Distillation Range @ 760 mm, °C	Within 6° spread Including 94.9
Color APHA, max.	30
Aldehydes as acetaldehyde, % wt., max.	0.05
Water, % wt., max.	0.25
Specific Gravity @ 20°/20°C	0.9160-0.9185

Celanese* CHEMICALS

*Reg. U. S. Pat. Off.

BRIGHTON



BUILDS THE BIG ONES!

This Vessel is a heavy copper still kettle, riveted and silver brazed—used for chemical distillation. Building huge kettles like this is an important part of our business at Brighton.

We work metal—stainless steel, copper, bronze, aluminum, nickel, monel metal and other alloys. More important, our craftsmen make metal work for you! They build with precision to your specification, select highest quality tested metals, finish your job with a thoroughness that only true craftsmen can provide. Heart and pride are in their work.

We have facilities and skilled metalsmiths to build chemical process equipment of virtually any size—pilot model to full scale. Typical work—fractionating columns, heat exchangers, pressure vessels (jacketed or unjacketed), agitating equipment, tanks, coils, evaporators. We will be happy to submit a prompt estimate on your fabrication job. Write today for full information.

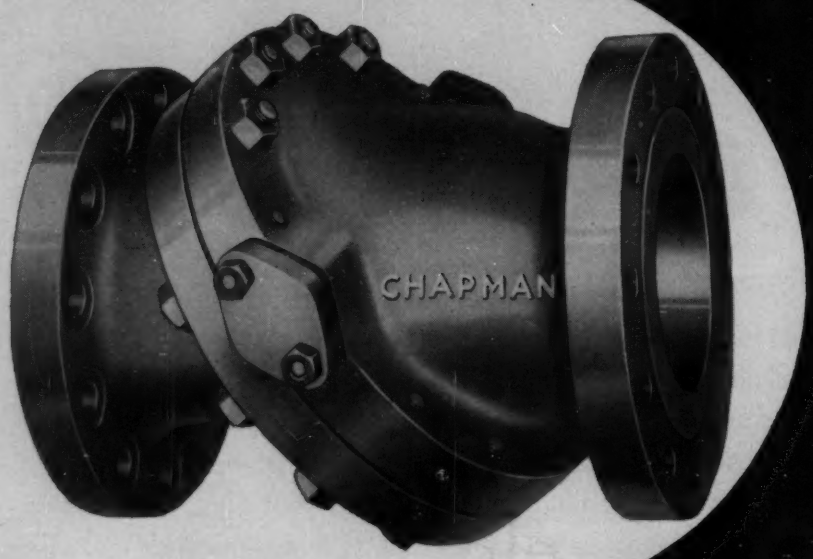
Have Brighton Bid Your Big Ones!

BRIGHTON COPPER WORKS, INC.

822 State Avenue, Cincinnati 4, Ohio

Process Equipment for the Chemical Industries Since 1914

CHAPMAN TILTING DISC CHECK VALVE

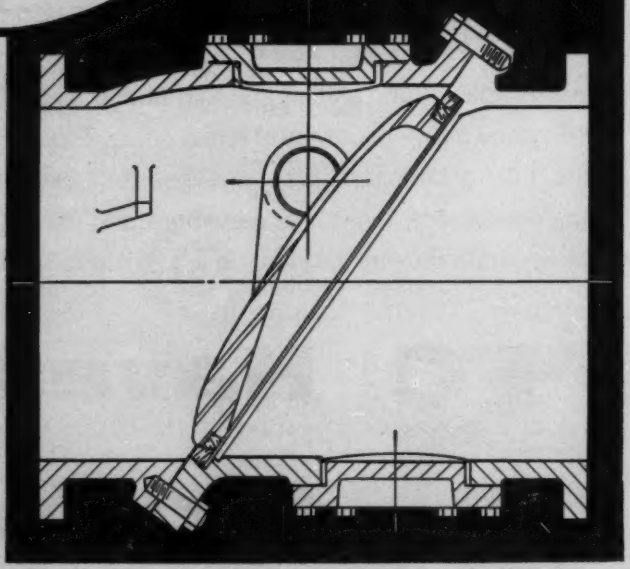


the Valve with the Right Idea!

Here is a cross section of top check valve performance at lowest cost. It's the idea in back of Chapman's Tilting Disc Check Valve . . . the valve that's designed to go with the flow.

When the flow is on, specially designed "airfoil" disc balances perfectly in open position. Fluid holds it tightly against stops. There's no vibration . . . no flutter. It's quiet. And note the design. Ample room is allowed around disc to assure low flow resistance.

When the flow is reversed, disc drops surely, quietly, *tightly* on special beveled seat. There's no banging, no slamming, no scraping or wearing of disc and seat faces, no damage to piping joints or the valve itself. It's as simple as that. It's as *sound* as that. It has the right idea.



Complete information on these rugged, quiet, long life check valves is highlighted in our Catalog 30-A. Whether you want iron or steel construction . . . whether you handle fluids or gases under a wide range of pressures . . . this catalog gives you all the facts. Send for your up-to-date copy, today.

The CHAPMAN VALVE Mfg. CO.

INDIAN ORCHARD, MASS.

Custom Designed

For a Bigger Yield

Higher yield in your case may mean cleaner, dryer cake . . . or better recovery of solubles . . . or just plain fast, trouble-free operation on a job that's got to be done. If you can get a few points better efficiency at no extra cost, why not?

FEinc custom-designed continuous vacuum filters have been doing just this for 37 years: For instance:

- Replaced six settling tanks in recovering plastic grinding waste . . . paid for itself in 3 months
- Reduced moisture in iron pigment from 68 to 59%
- Cut recycling of difficult gelatinous sulphate cake from nine to five cycles
- Eliminated plugging, gave three hours more running time daily on sticky clay
- Reduced solubles in metallic stearate from 0.5 to 0.05%
- Recovered ⅔ of chromates left by competitive filter

All types of continuous rotary vacuum filters . . . string, horizontal, scraper, precoat, etc. . . . are custom designed and manufactured by FEinc . . . quality built because quality pays you. Ask for bulletins . . . or for recommendations . . . no obligation, of course.

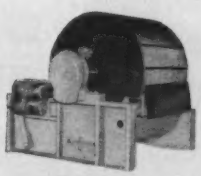
47

For a Bigger Yield **FEinc**

FILTRATION ENGINEERS, INC.
155 Oraton Street, Newark 4, N. J.

STRING

HORIZONTAL

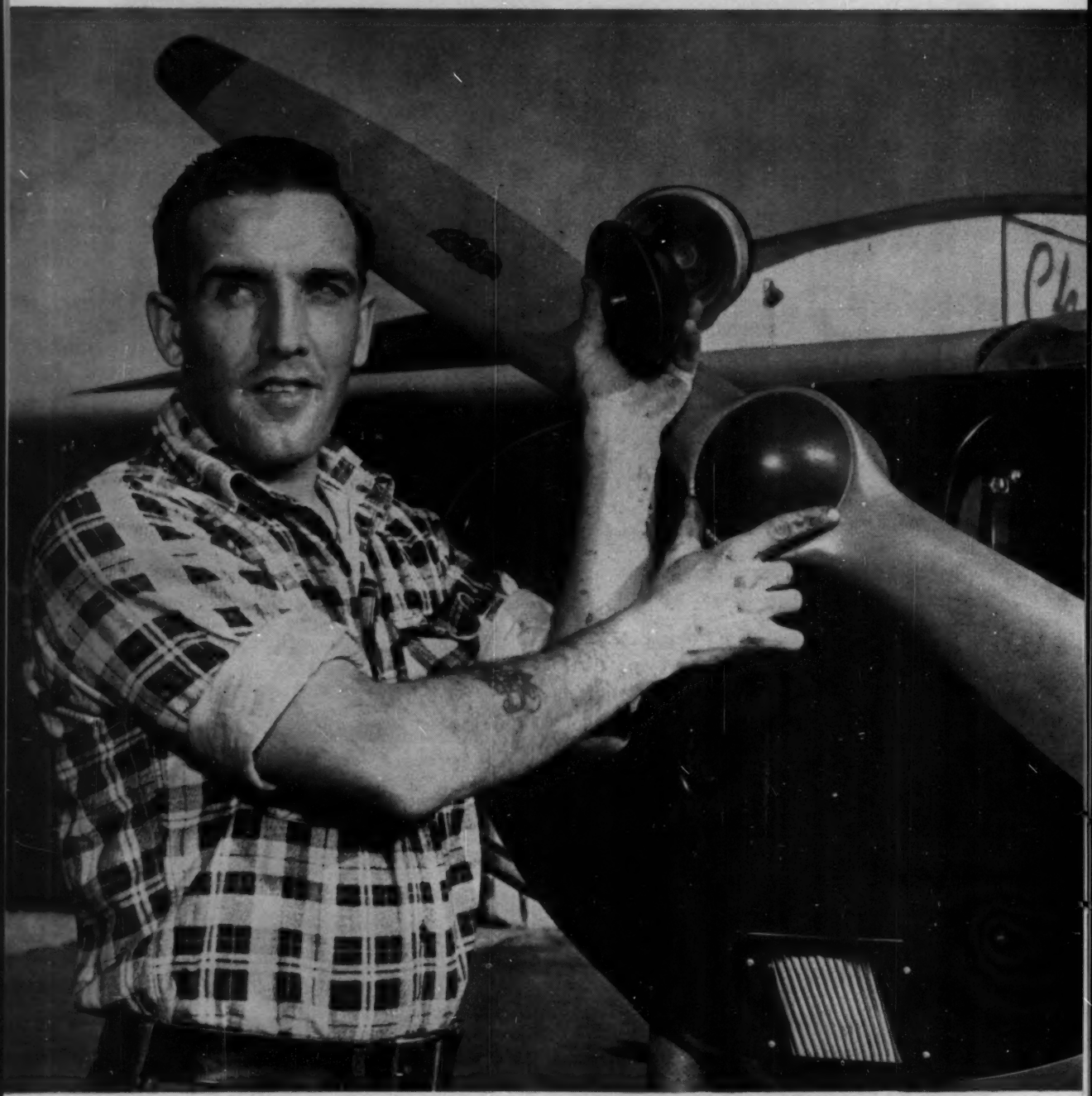


SCRAPER

CUSTOM DESIGNED CONTINUOUS FILTRATION

Another Opportunity Chemical from General Mills

Tough, low-cost plastic easy to make with



Plastic lathe fixture, left, is used to make propeller spinners at Champion Aircraft Corp.

**Investigate Versamids the versatile polyamide resins made only by...*

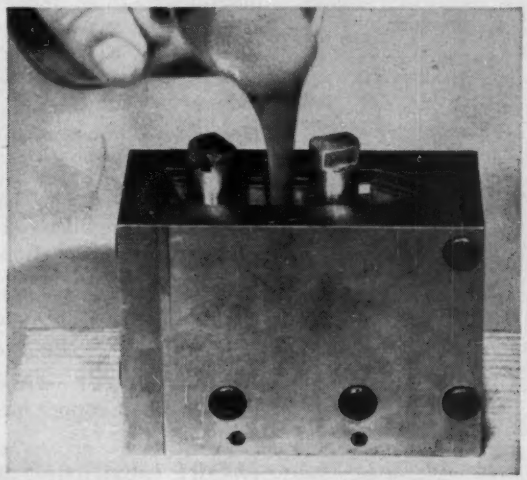
CHEMICAL DIVISION

tools and dies are Versamid*-epoxy alloys!

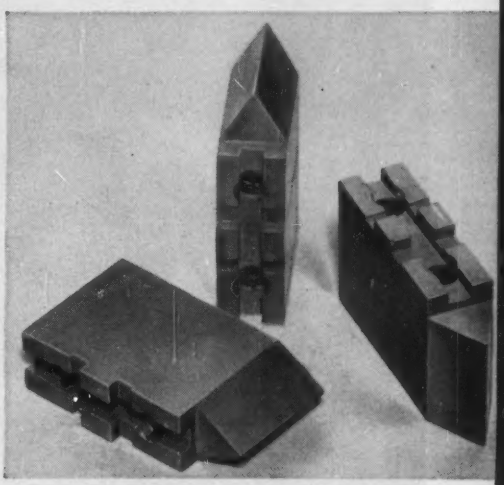
Strong, lightweight plastic tools have passed rigid, practical tests and are in daily use in aircraft, automotive and other industries. Champion Aircraft Company of Osceola, Wis. is one of many manufacturers who have found Versamid-epoxy alloy tooling economical, efficient, and a valuable aid to their business. Thermosetting alloys of Versamid-epoxy resins are being used to produce aluminum and even heavy gauge steel stampings. These alloys show high impact strength, are extremely easy to work with, and can be formulated to yield almost any set of properties desired.

It's easy to make durable Versamid-epoxy tools, as shown below.

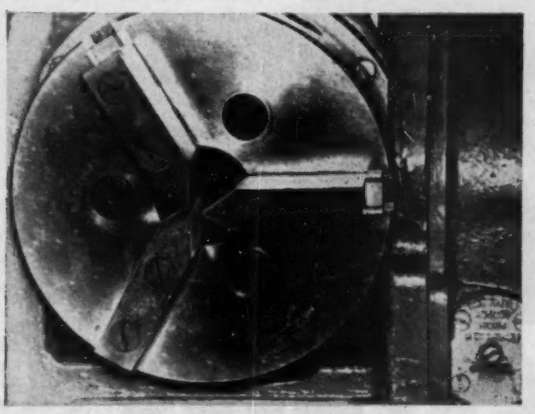
Maybe tools and dies aren't your problem, but chances are you can use Versamid polyamide resins to save time and money in other applications. Tough industrial finishes, plastic body solder, structural adhesives, rugged plastic laminates . . . these are but a few of the known and tested uses for versatile Versamids. Only Versamid polyamide resins do so many jobs so well, and only General Mills makes Versamids.



1. Here an alloy of Versamid 125, epoxy resin, and aluminum powder is poured into a brass mold.



2. These soft jaws, or chucks, are molded from Versamid-epoxy alloy at extremely low cost.



3. Finished three-jaw chuck is in regular use on a lathe at General Mills Mechanical Division.

For more detailed information, write for the Spring issue of *Progress Thru Research.* It carries a fact-filled article on plastic tooling. If possible, name your needs for specific advice on the application you're considering. Please note that General Mills does not market plastic tool and die alloys . . . only the Versamid polyamide resins used in such alloys.

OF General Mills KANKAKEE, ILLINOIS

There's MORE — rating selection available in Allis-Chalmers MOTORS

To meet processing needs...

Allis-Chalmers Offers Complete Line of Rib-Type MOTORS from 1 to 100 Hp

Allis-Chalmers, a pioneer in rib-type TEFC motor design, is the only leading manufacturer offering a complete line of these motors from 1 to 100 hp. The many cost-saving features of deep-rib construction can be applied in a variety of uses... both indoors and out.

Here's why these motors can cut processing costs:

MORE cooling surface — Rib-type design provides reserve cooling capacity in dirty locations.

MORE iron—Cast-iron frame and external parts assure rigidity and resistance to corrosion.

MORE copper — Allis-Chalmers greater use of copper increases electrical life.

MORE lubrication provisions — Large grease reservoirs surround bearings. Provision made for in-service relubrication — important where moisture or corrosive vapors contaminate grease.

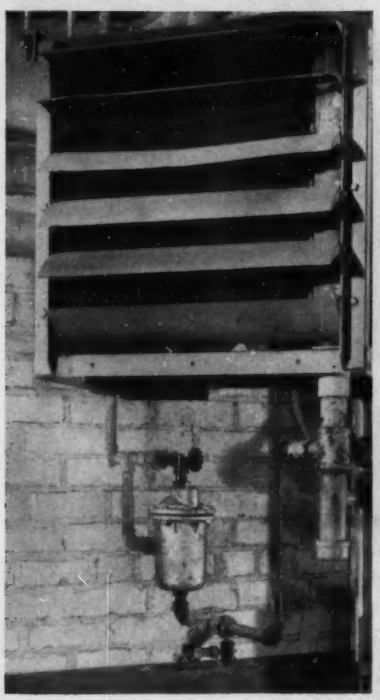
As a new machinery component or as replacement, specify Allis-Chalmers. To find out more, contact your nearby Allis-Chalmers distributor, district office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

A-4947

ALLIS-CHALMERS

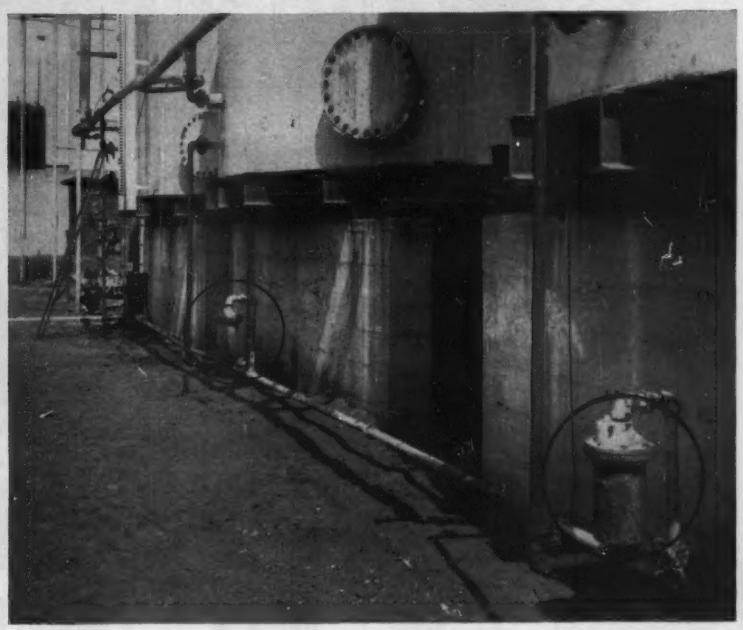
A-C ALLIS-CHALMERS

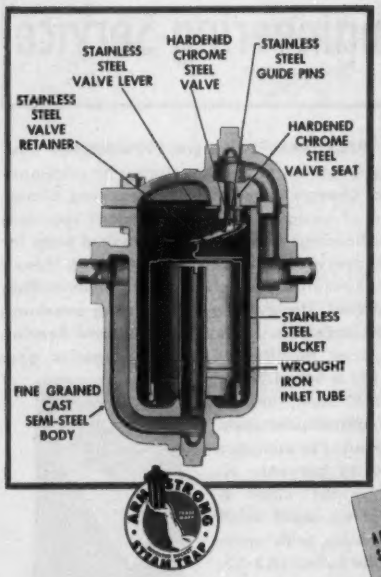
Major Chemical Company Reports Armstrong Traps Cost Less to Maintain



INDOORS—Mr. George Gentes, Works Manager at Hooker Electrochemical Co., Tacoma, Wash., says, "We feel that we get excellent service with Armstrong traps. We have been using them for about 10 years."

OUTDOORS—these Armstrong traps give year 'round service at Hooker's big Tacoma plant.




STAINLESS STEEL VALVE LEVER
HARDENED CHROME STEEL VALVE
STAINLESS STEEL GUIDE PINS
STAINLESS STEEL VALVE RETAINER
HARDENED CHROME STEEL VALVE SEAT
STAINLESS STEEL BUCKET
WROUGHT IRON INLET TUBE
FINE GRAINED CAST SEMI-STEEL BODY
ARMSTRONG STEAM TRAP

Simple, dependable Armstrong traps mechanisms have only two moving parts—bucket and lever. Design, materials and workmanship in low and medium pressure traps identical to that of traps for 900 lbs., 900°F service!

Trap's Lot is a Hard One. A steam trap takes a lot of punishment. On some jobs it may operate *1,000,000 times a year*. The parts are subjected to dirt, scale and corrosive substances, high temperatures and the erosive action of the condensate.

Armstrong's Take it Well. Armstrong traps endure these conditions remarkably well. In reporting on less trap maintenance since installing Armstrong traps Mr. George Gentes, Works Manager of Hooker Electrochemical Company's plant at Tacoma, Washington stated:

"We get excellent service . . . our trap maintenance cost is very low."

Others Agree. More Armstrong customers mention low maintenance than any other single benefit. That means more than low repair costs. It means freedom from leaky traps that waste steam, freedom from faulty traps that slow up production—freedom from *trouble*.

A Suggestion. Send for the Armstrong Catalog listed below or, better yet, call your local Armstrong Representative or Distributor—he's exceptionally well qualified to help you improve your trapping situation.

ARMSTRONG MACHINE WORKS
858 Maple Street • Three Rivers, Michigan

FREE
44-PAGE STEAM TRAP BOOK—Send for yours—no obligation.

ARMSTRONG MACHINE WORKS
858 Maple Street, Three Rivers, Michigan
Please send Steam Trap Book to:

Name_____
Company_____
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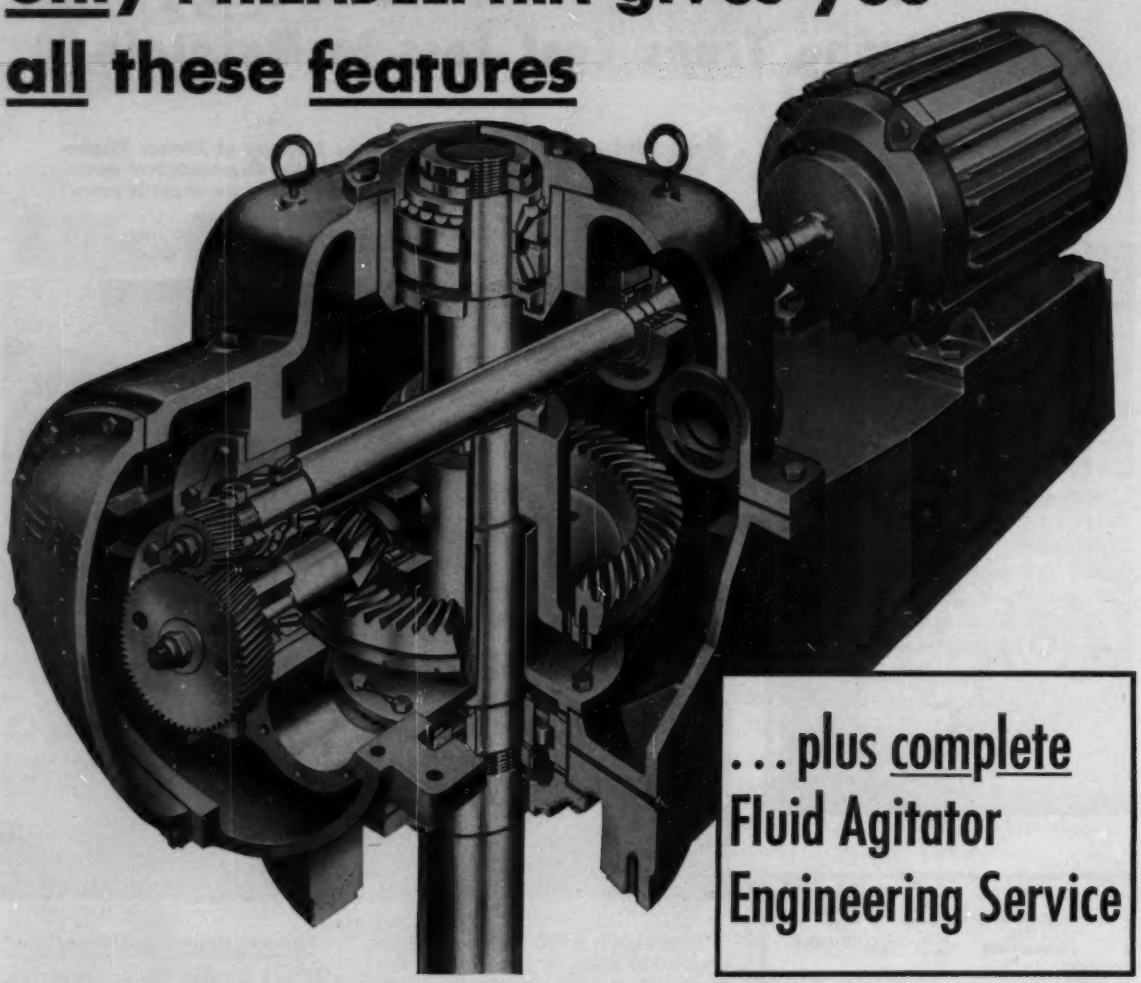
City_____ Zone___ State_____

only PHILADELPHIA gives you all these features



. . . plus complete Fluid Agitator Engineering Service

Now, for the first time one manufacturer is able to offer a completely integrated, "packaged" fluid agitator service. No other manufacturer controls, within its own organization, such extensive and specialized designing, engineering, manufacturing, assembling, testing, and field servicing facilities devoted exclusively to fluid agitator production. Philadelphia Gear Works manufactures impellers, shafts, drive supports, all gears, and reducer housings. Only Phillie Gear can offer you the complete solution of your fluid agitator problems —through one centrally-controlled, thoroughly responsible source.

Our engineers are familiar with the requirements of all types of process mixing and fluid agitation applications.

Philadelphia Gear Works products have "measured up" through 63 years of industrial leadership. Compare the new Philadelphia Fluid Agitators for economy, efficiency and quality. See for yourself why Philadelphia Fluid Agitators are your very best investment.

COMPARE THESE FEATURES: Exclusive Philadelphia Low Head Room Design—maximum bearing span with minimum headroom ● Helical Change Gear Set, within housing, allows for ready selection of up to 14 different standard speeds ● Heavy Duty Thrust Bearings permit use of standard units for conditions of high pressure in closed tanks ● Large Heavy Duty Output Shafting results in less shaft deflection at stuffing box or mechanical seal, steady operation of long overhung agitator shafts ● Philadelphia Heavy Duty Inboard Bearing Support provides extra rigidity resulting in superior gear performance and life ● Spiral Bevel Gears of Hardened Steel, accurately lapped for long and quiet operation ● Field-proven Philadelphia Dry-Well Construction prevents oil leakage down output shaft ● Labyrinth-type seal on input shaft allows effective sealing with minimum friction ● Ask for Bulletin A2-55.

PHILADELPHIA GEAR WORKS, INC.

ERIE AVE. & G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.
BALTIMORE • CLEVELAND
Virginia Gear and Machine Corp., Lynchburg, Va.

Industrial Gears & Speed Reducers

LimiTorque Valve Controls

Established 1892

So many things today use a *Dexstar Specialty Paper* in place of other material.

Perhaps *you* could, too — to make *your* products *better*, for *less*.

We'd be happy to discuss possibilities.

We've been custom-making *specialty papers* for a hundred years for hundreds of people.

A simple inquiry can put our complete research and development laboratories, our modern machinery — *at your service!*

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SPECIALTY PAPERS FOR INDUSTRY

. . . made from natural, synthetic and glass fibers

do you want low-cost corrosion or contamination

Acetone • Alcohol • Calcium Acetate • Calcium Carbonate • Calcium Chloride (Flake) • Ethyl Acetate • Ethyl Alcohol • Ethylene Glycol • Glycerine • Insecticide Concentrates • Isopropyl Acetate • Soda Ash • Sodium Bicarbonate • Sodium Silicate •

CF&I LECTRO-CLAD® Nickel Plated Steel Plates will give it to you

Yes, you can get low-cost, yet effective protection against contamination and corrosion with all these chemicals. . .and many more!

Effective in heavy industrial applications where the corrosion rate does not exceed 0.0015 inches per year, CF&I LECTRO-CLAD Nickel Plated Steel Plate successfully combine the corrosion and contamination resistance of nickel and the economy and strength of carbon steel.

That's because CF&I LECTRO-CLAD is made by the Bart Process, which consists of electrodepositing a heavy layer of 99% pure nickel on a carbon steel plate. This process results in a permanent bond between the nickel and the steel base. The nickel plating is customarily supplied in the 8-10 mil range; however, it can be plated up to 15-20 mils, if specified.

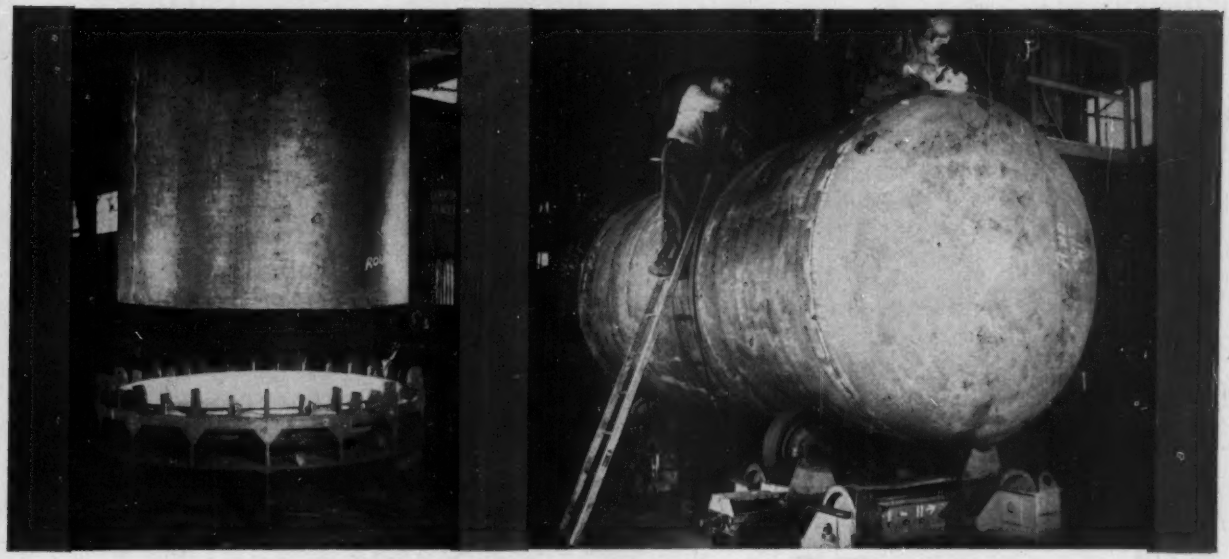
What's more, CF&I LECTRO-CLAD Nickel Plated Steel Plates are easily fabricated without costly special equipment. Just use regular shop equipment and bend it...weld it... roll it—the protective nickel layer will not check, spall or flake!

Ask our nearest sales office for the complete story on economical, effective, easy-to-fabricate CF&I LECTRO-CLAD Nickel Plated Steel Plate* today. Wickwire Spencer Steel Division, The Colorado Fuel and Iron Corporation, P. O. Box 1951, Wilmington, Delaware.

*CF&I LECTRO-CLAD Nickel Plated Steel Sheets, Pipe, Fittings and Heads are also available.

protection against with these chemicals?

Caustic Soda • Chlorinated Hydrocarbons • Cold Hydrofluoric Acid • Dibutyl Phthalate
Methyl Alcohol • Petroleum Catalysts • Phenol • Potash • Resin Plasticizers • Salt
Sodium Sulphate • Titanium Dioxide • Tricresyl Phosphate



Assembling a tank fabricated from CF&I LECTRO-CLAD Nickel Plated Steel Plates.
The heads have also been nickel electroplated by the Bart Process.

3798

Claymont Steel Products

CF&I

Products of Wickwire Spencer Steel Division • The Colorado Fuel and Iron Corporation

Abilene • Albuquerque • Amarillo • Atlanta • Billings • Boise • Boston • Buffalo • Butte • Casper • Chicago • Denver • Detroit • El Paso • Ft. Worth • Houston • Lincoln (Neb.) • Los Angeles
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CANADIAN REPRESENTATIVES AT: Edmonton • Toronto • Vancouver • Winnipeg

OTHER CLAYMONT PRODUCTS

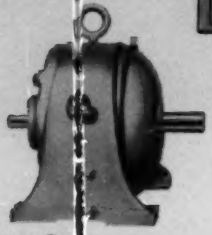
Stainless-Clad Plates • Manhole Fittings and Covers • Large Diameter Welded Steel Pipe
Flame Cut Steel Plate Shapes • Flanged and Dished Heads • Carbon and Alloy Steel Plates

Here's your

"Buyer's Guide"

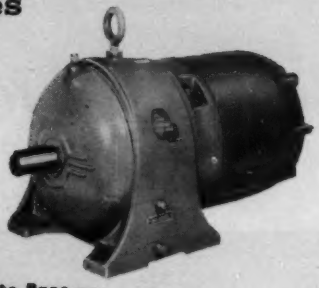
to the world's finest enclosed gear drives

FOOTE BROS. standard enclosed gear drives



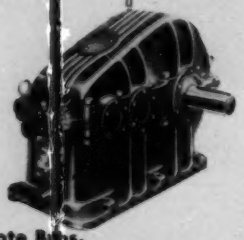
Foote Bros. Line-O-Power Drives

Available in straight line and right angle units. Line-O-Power drives feature Duti-Rated gearing. Foot or flange mounted, single, double, triple or quadruple reduction. Cast housing assures permanent alignment. Ratios to 2726 to 1. CATALOG LP NO. 3.



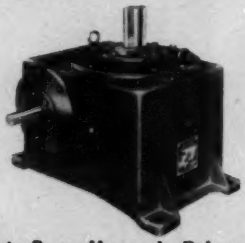
Foote Bros.— Louis Allis Gearmotors

Famous, dependable Louis Allis motors and Foote Bros. quality Duti-Rated Gearheads form a perfect combination for power. Capacities range to 150 h.p., output speeds to 780 r.p.m. Available foot or flange mounted, horizontal or vertical models. CATALOG MD.



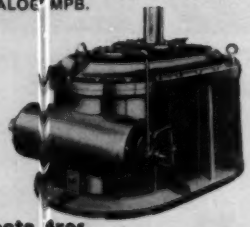
Foote Bros. Maxi-Power Drives

Compact, rugged helical geared units provide years of trouble-free, dependable performance. Designed for severest service. Available in ratios up to 360 to 1, capacities to 1550 h. p. CATALOG MPB.



Foote Bros. Hygrade Drives

Here's high efficiency and load carrying capacity for heavy duty. Precision worm geared Hygrade drives are available in ratios up to 4108 to 1, capacities to 260 h.p. CATALOG HGB.



Foote Bros. Worm-Helical Gear Drives

Designed for heavy-duty stirring, mixing or agitating applications, Foote Bros. Worm-Helical Drives are available with horizontal input shaft, vertical up or down or both output shaft. Ratios range to 285 to 1, capacity to 128 h. p. CATALOG WHB.

For complete details on any one, or all, of the drives shown here, write for informative literature . . . note specific catalogs designated. There's a size and type Foote Bros. drive to meet every need.

This trademark stands for the finest industrial gearing made

FOOTE BROS. Duti-Rated LIFETIME GEARING

T.M. REG. U.S. PAT. OFF.

FOOTE BROS.

Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION

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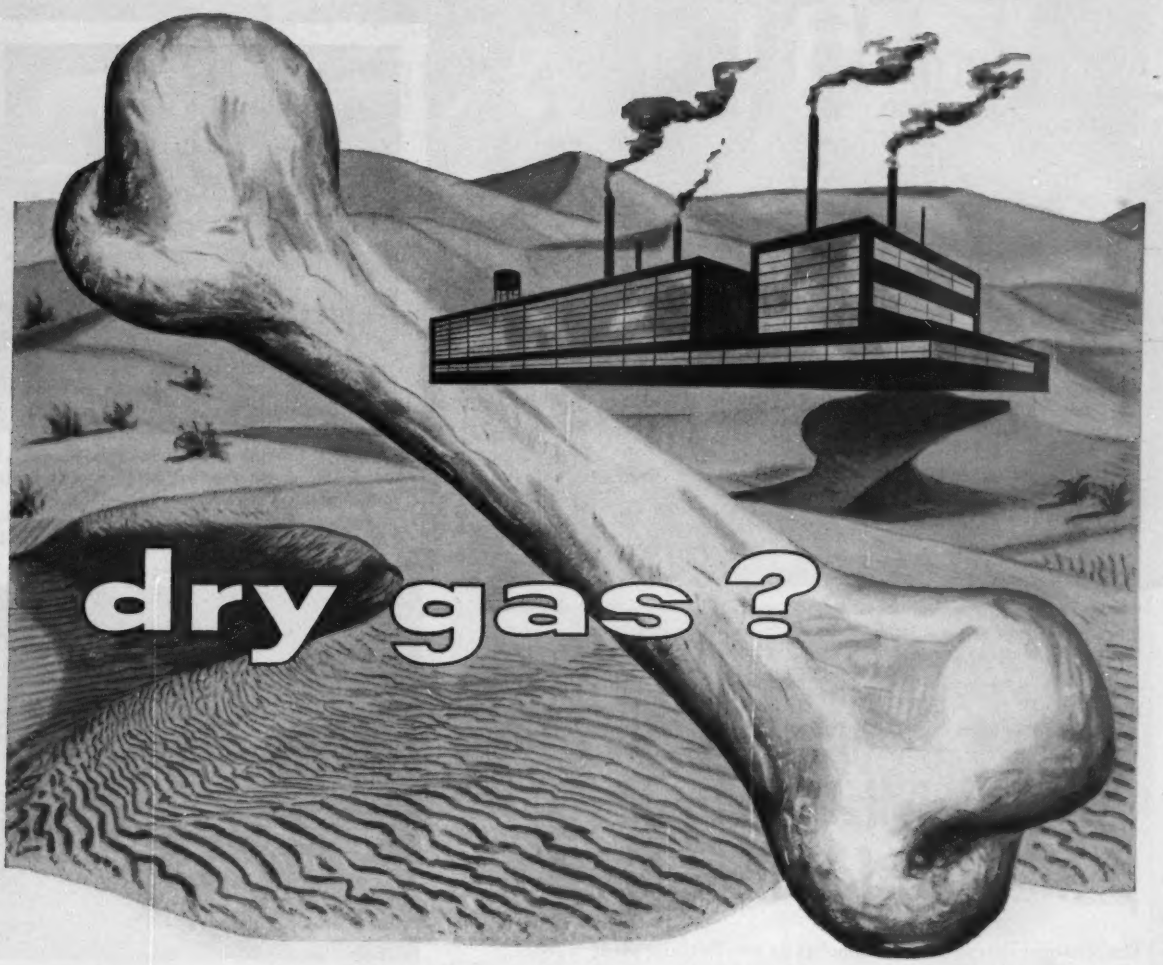
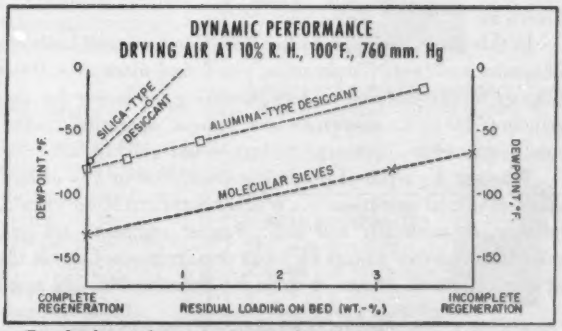


Now you can dry gases drier than dry!

LINDE Molecular Sieves can dry your gases—air, hydrogen, chemical streams—more thoroughly than any other commercial adsorbent. They will duplicate laboratory performances—*in your plant*—under normal *production* conditions.

Even though your gas stream may already be partly dried, Molecular Sieves will remove the last traces of moisture. Only a small volume of adsorbent is required. The same combination of high capacity and low dewpoint is also obtained at high temperatures, up to 200°F.

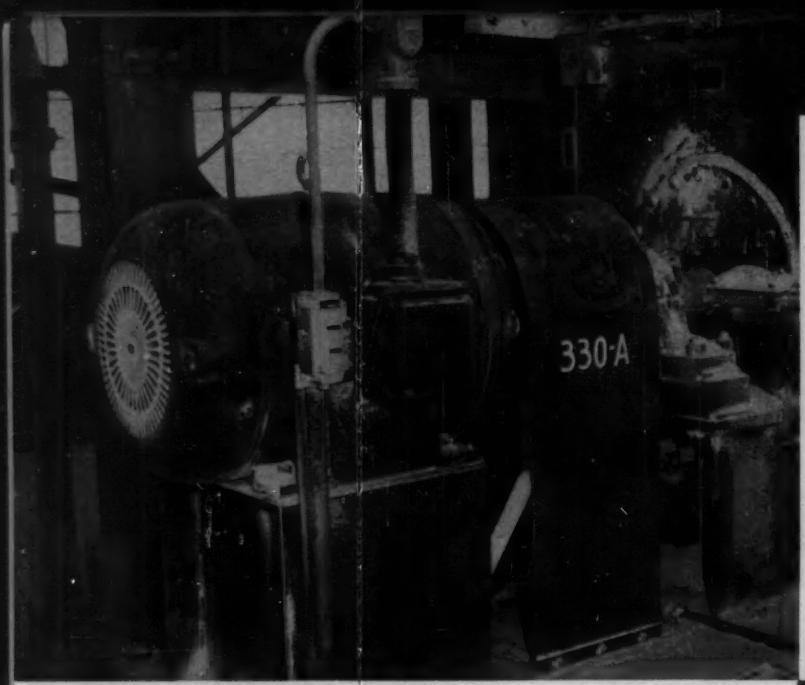
This is SUPER-drying! Dynamic performance is shown in the accompanying graph. This superior performance also can be expected at higher relative humidities and at other temperatures and pressures. Of particular significance in production is the relative insensitivity of Molecular Sieves to incomplete regeneration.



For further information, write for data sheets on "Drying of Gases." Address Dept. CG-5, Linde Air Products Company, A Division of Union Carbide and Carbon Corporation, 30 East 42nd St., New York 17, N. Y.

Linde TRADE MARK MOLECULAR SIEVES

The term "LINDE" is a registered trade-mark of Union Carbide and Carbon Corp.



WHERE DUST PREVAILS—A 60 hp, 1160 rpm Wagner motor drives this pulverizer which grinds down oversize fertilizer. Its totally-enclosed construction keeps fertilizer dust out and mechanical and electrical stability in.

Wagner Standard Motors do specialized jobs at Missouri fertilizer plant

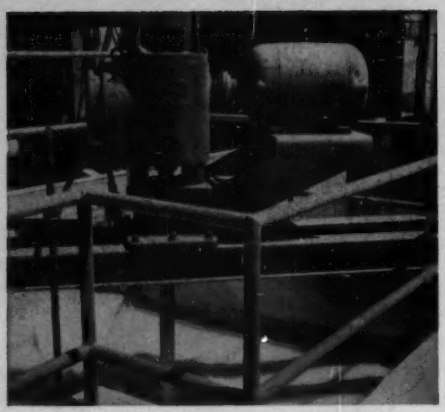
The Missouri Farmers Association has its own fertilizer plant in Joplin, Missouri. Technically, it is called a "high analysis granulating unit." Principal chemical compounds manufactured are phosphoric acid and ammonium phosphates. With an annual capacity of 70,000 tons of fertilizer, this farmer-owned plant is one of two of its kind in North America.

In this plant, designed by the Dorr Company and built by Merritt-Chapman and Scott Corporation, you'll find more than 100 standard Wagner totally-enclosed motors providing the power for pulverizers, grinders, blowers, conveyors and pumps, operating under adverse conditions—where open-type motors would quickly fail.

Whether it's a job of producing plant food or any of hundreds of other industrial operations . . . Wagner Standard Motors can do the job reliably, economically and well. Wagner engineers are qualified to specify the correct motors for *your* requirements. Consult the nearest of our 32 branch offices—or write for Bulletins MU-132 and MU-203.

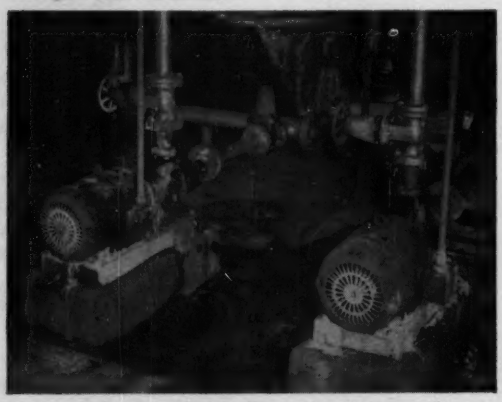
Wagner Electric Corporation
6407 Plymouth Ave. • St. Louis 14, Mo., U.S.A.

WH56-3



PERMITS OUTDOOR OPERATION—This Wagner 15 hp, totally-enclosed, fan-cooled motor drives an agitator which mixes hydrated lime with plant water. This motor's totally-enclosed, corrosion-resistant, cast-iron construction protects it from the elements and keeps it always "on the job."

AT REDUCED SPEED—In this application, a 100 hp, 1160 rpm Wagner motor drives a Rotary Fertilizer Drier at 5 rpm through a Falk Motoreducer.



IN CORROSIVE ATMOSPHERE—These 5 hp, 3500 rpm Wagner motors drive pumps that handle 93% sulphuric acid. But even sulphuric acid is no deterrent to the reliable operation of these motors because of their corrosion-resistant cast-iron frames and totally-enclosed construction.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

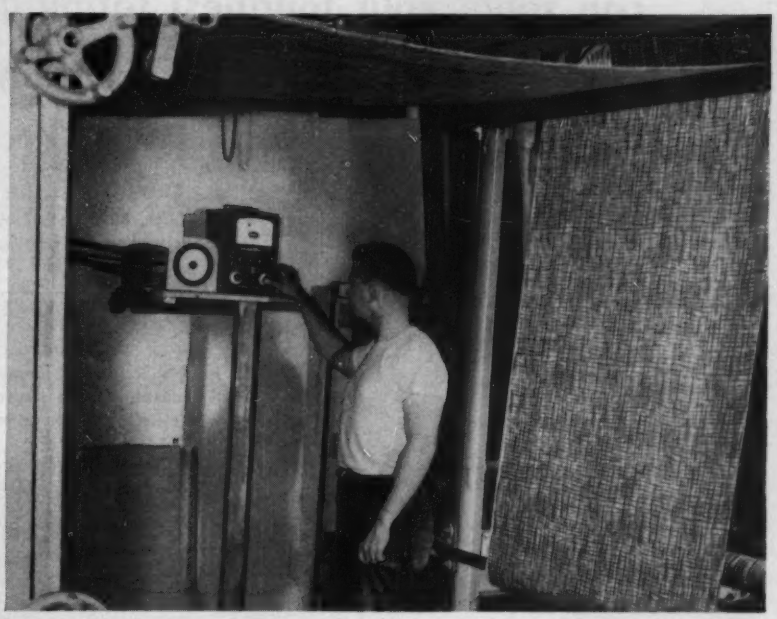
How to Control Heat in a Large Oven

No. 4 of a series — *Showing the Broad Application Range of Fenwal Controls*

The oven is designed to dry 30 yards of finished goods per minute at oven temperatures up to 400°F. The problem was to maintain the desired 330°F in the oven. Here's how this was accomplished —

The many electric heaters, which are distributed uniformly in the oven, provide a total heat input of about 60,000 watts and are divided into two separate control circuits. About one-third of the heaters are controlled by a simple on-off controller of moderate sensitivity to maintain a basic heat level in the oven. The remaining heaters are operated by the Fenwal Series 560 Portable Temperature Indicating Controller, an instrument of high sensitivity and rugged construction. The Series 560 provides the proportioned heat necessary for accurate control of the curing process. It also can be used for straight on-off control. Here's the way the control set-up works —

To maintain the desired 330°F in the oven, the on-off controller is set at 315°F, while the proportioning controller is set at 330°F. So both heater circuits are on during oven warm-up or when incoming fabric depresses the oven temperature below 315°F. Above 315°F, the on-off controller shuts off the heaters in its circuit, and the process heat is obtained from the remaining heaters under the control of the Fenwal Series 560 Controller.



THIS 600 CUBIC FOOT CURING OVEN, planned and installed by Atlas Textile Machinery Co., Paterson, N. J. at the Gsell Textile Printing Corp. plant in New York, uses the Fenwal Series 560 Portable Temperature Indicating Controller to provide uniform drying conditions within 2 degrees of the set point.

Integrated Sensitivity a Big Advantage in The Series 560

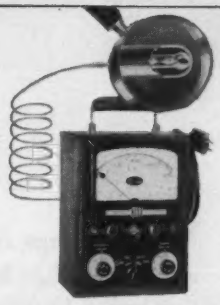
In the Fenwal Series 560 Temperature Indicating Controller the superior thermoelectric qualities of the revolutionary thermistor are used to fullest advantage. The great resistance change of the thermistor in response to temperature change results in extreme sensitivity. It also enables the use of a simple null balance bridge circuit for increased stability. And it permits the use of a standard electric conductor as a connecting wire — *no special wire is required.*

These characteristics have been *integrated* by Fenwal into a rugged, durable instrument which is the first to combine all three major modes of indicating control — on-off, proportional and adjustable differential — *all functioning with high sensitivity at the flip of a switch.*

Proved Applications

Fenwal Sales Representatives and Engineers have saved time, trouble and money in all types of plants and laboratories by solving thousands of temperature control and detection problems. Fenwal THERMOSWITCH® units are controlling processes that involve liquids, gases and solids.

Put Fenwal's vast reservoir of technical know-how to work for you. Chances are your problem has already been met and mastered by Fenwal engineers. Write for Catalog No. 500 for complete information.



SERIES 560 INDICATOR CONTROLLER with magnified cutaway view of thermistor probe.

FENWAL INCORPORATED
165 Pleasant Street
Ashland, Mass.

Please send me your Catalog No. 500. Our specific problem is:.....

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Name.....*Title*.....

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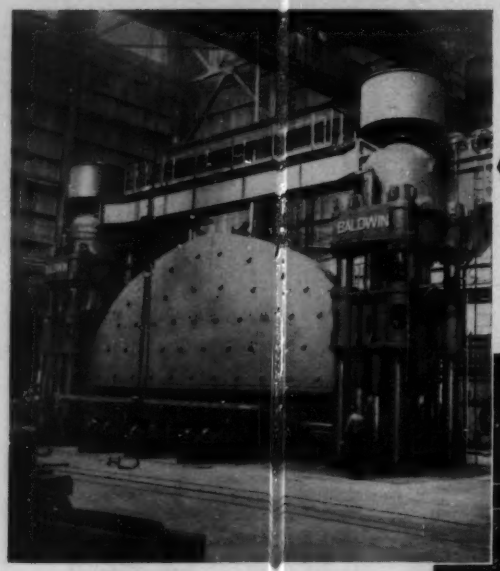
City.....*Zone*...*State*.....

Fenwal **CONTROLS TEMPERATURE . . . PRECISELY**

Foster Wheeler's exceptional facilities for

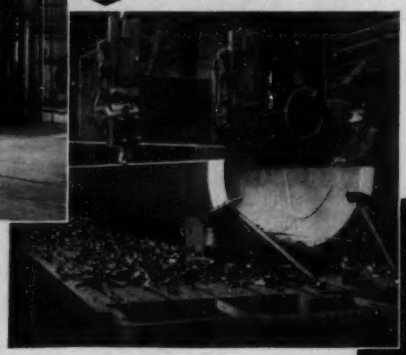
HEAVY FABRICATION

can solve your toughest forming, machining and welding problems



This huge, 8000-ton hydraulic beam press easily performs bending and forming operations on steel plates up to 9 inches thick and 39 feet in length.

Here, on one of the largest double housing planers in the country, welding grooves are machined in one half of a cylinder for a large pressure vessel.



Twin arc automatic submerged arc welder joins two longitudinal half shells for a 6-inch thick pressure vessel.

With four large and exceptionally well equipped plants — at Carteret, N.J., Mountaintop, Pa., Dansville, N.Y. and St. Catharines, Ontario — Foster Wheeler offers a unique fabricating service to industry. High-pressure vessels, heavy-wall pipe and unusual weldments to Code requirements and beyond, as well as your lighter fabrications, can be produced by the most modern and efficient methods, with substantial savings in time and cost.

For More Complete Information on Foster Wheeler fabricating facilities, send for your copy of our new, 20-page Bulletin No. GS-56-4. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

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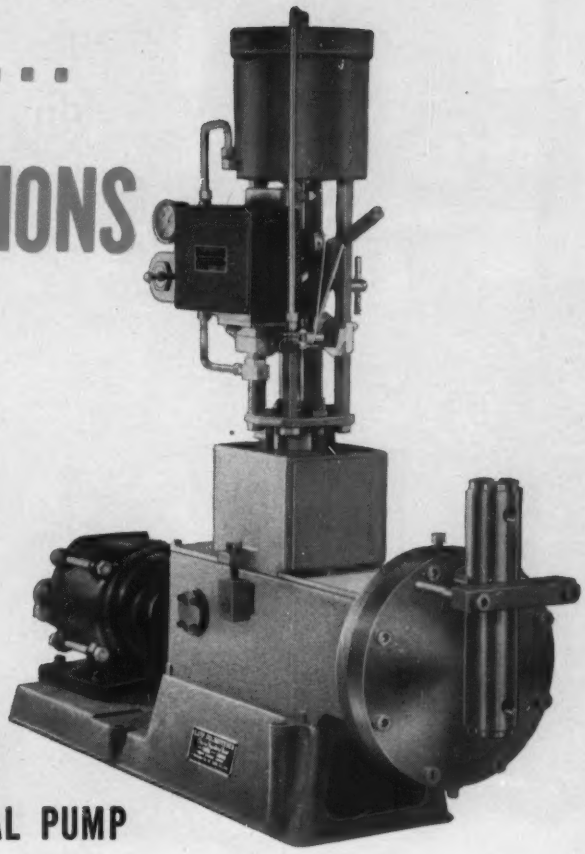
IT PUMPS...

IT METERS...

IT PROPORTIONS

IT FEEDS...

WITHOUT LEAKAGE OR CONTAMINATION



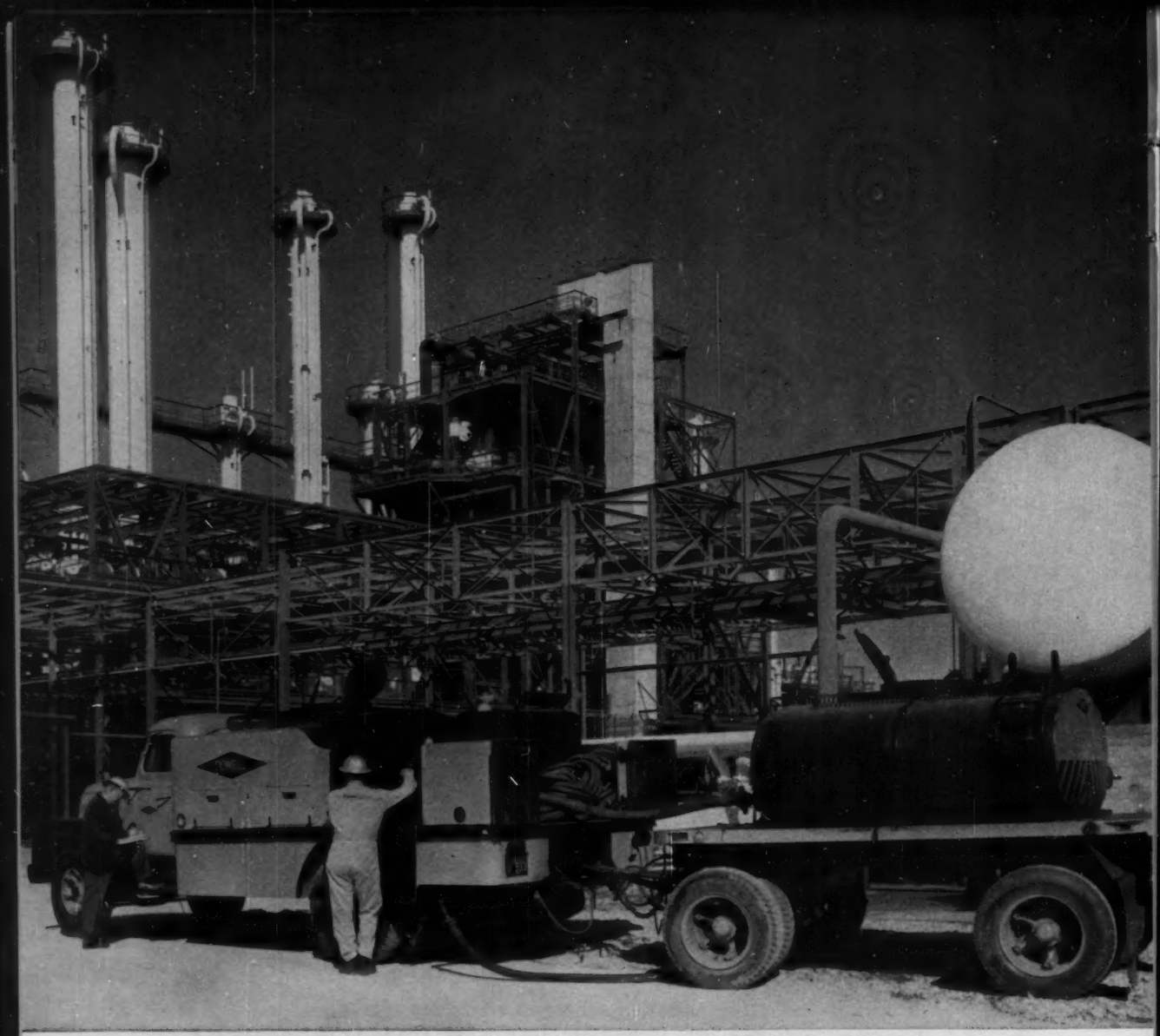
Lapp PULSAFEEDER

CONTROLLED-VOLUME CHEMICAL PUMP

If your process requirements demand accurate handling of corrosive and non-corrosive liquids, here is the pump for the job. The Lapp Pulsafeeder is a piston-diaphragm pump . . . it has positive displacement with *no stuffing box*. The product being pumped is isolated from the drive mechanism by a hydraulically balanced diaphragm, thus preventing leakage or contamination of the product. Pumping speed is constant; variable flow results from variation in piston-stroke length . . . controlled manually by hand-wheel, or, in Auto-Pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable.

WRITE FOR BULLETIN 440 *with typical applications, flow charts, description and specification of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Division, 476 Wilson Street, Le Roy, N. Y.*

Lapp



IT'S NOT WORTH THE CHANCE —CLEAN IT RIGHT

Equipment that operates at less than peak efficiency eats into your company profits. Chemical cleaning can help stop these losses—but only when it's done by experts. Unless you rely on experts, you're taking a chance with your men and valuable equipment.

Dowell engineers understand your cleaning problems and they have the *experience* needed to solve them. Thoroughly trained, they're backed by Dowell's 15 years' experience in removing troublesome scale deposits from virtually every kind of equipment in every kind of industry. They're aided, too, by a completely modern, fully staffed and excellently equipped *research* laboratory.

But, expert cleaning goes beyond keeping your equipment in top condition. Dowell considers the safety of company personnel at every step of the operation. The safest possible working procedures are worked out with your safety personnel.

Call Dowell. Our engineers are always ready to discuss chemical cleaning problems with you. There's no obligation. Or write Dowell Incorporated, Tulsa 1, Okla., Dept. E-33.

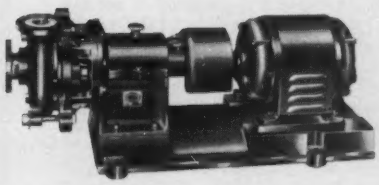
chemical cleaning service for industry **DOWELL**

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Penicillin...

begins with WILFLEY ACID PUMPS

In chemical plants throughout the world many of the complex solutions used in the production of life-saving anti-biotics are handled efficiently and economically by WILFLEY ACID PUMPS. Absolute dependability under the pressure of 'round-the-clock schedules has established WILFLEY as the leader in this field. Available with pumping parts of the machinable alloys as well as plastic to meet all requirements. Individual engineering on every application. Write or wire for complete details.



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DENVER, COLORADO, U. S. A.

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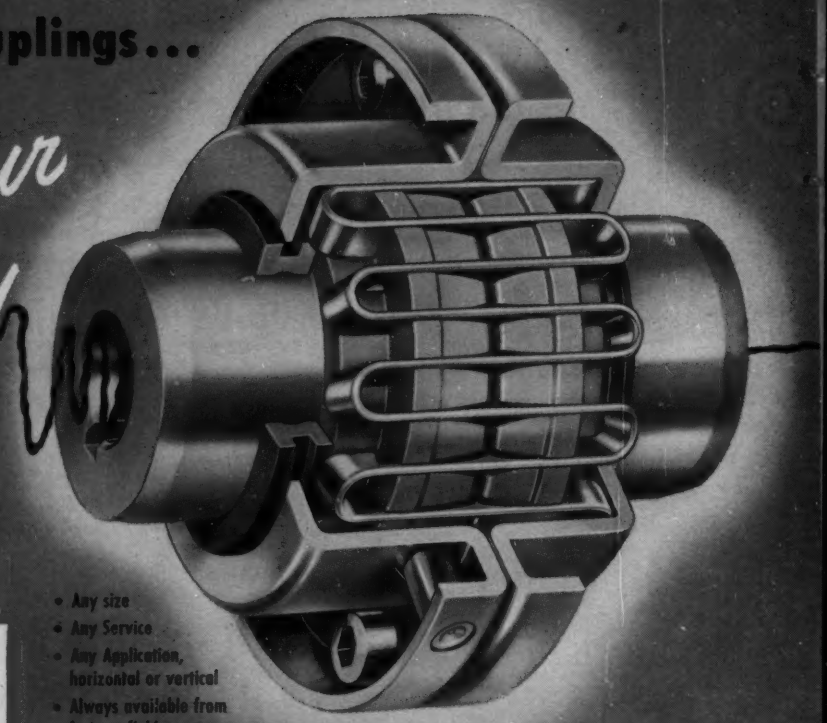
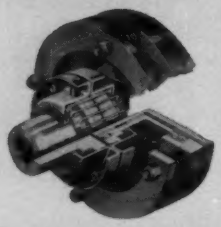
WILFLEY ACID PUMPS
"COMPANIONS IN ECONOMICAL OPERATION"
WILFLEY SAND PUMPS

Falk Steelflex Couplings...

Protect your machinery in 2 ways



- Any size
- Any Service
- Any Application, horizontal or vertical
- Always available from factory, field or distributor stocks

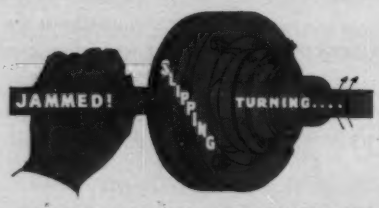


Falk Controlled Torque Couplings prevent damage from overloads

In applications where danger from overloads exists, use the FALK Type FT Controlled Torque Coupling. The Type FT has all the features and advantages of standard FALK Steelflex couplings—and, in addition, has an adjustable friction slip clutch, enabling the operator to set the coupling to slip at any predetermined overload.

This controlled-torque principle not only prevents transmission of dangerous shocks and limits overloads; it eliminates the breaking of shafts caused by jamming of driven equipment.

An outstanding advantage of the Type FT Coupling is that, as soon as the cause of the overload is removed, the entire coupling will rotate and transmit power without replacing parts or repairing coupling.



There's real economy in using Type FT Controlled Torque Couplings. Many users have reported that these couplings paid for themselves the very first time they slipped (under overload) because of the protection against damaged driving or driven machinery!

...cost less per year of service!

You get *double protection* when you connect your driving and driven machinery with a Falk Steelflex Coupling—the all-steel coupling with the exclusive grid-groove design! First, its *torsional resilience* smothers shock and vibration; and second, the Steelflex design prevents damage and lowered efficiency by accommodating shaft misalignment.

Why have increasing numbers of key men in industry standardized on Falk Steelflex Couplings? Their experience has proved that Falk Steelflex Couplings prolong the service life of their machinery... are trouble-free and need minimum maintenance... are easy to install, lubricate and disconnect... and *cost less per year of service* than ordinary couplings.

One basic Steelflex design—the type F, in its many sizes—is adaptable to more than 90% of all industrial applications. For applications involving danger from overloads, Modified Type FT Controlled Torque couplings (see column at left) are ideally suited. There are numerous other special or dual purpose Steelflex couplings for unusual applications. **Write to Department 247** for engineering bulletin, including selection and dimension tables.

THE FALK CORPORATION, MILWAUKEE, WISCONSIN

FALK

...a good name in industry

MANUFACTURERS OF:

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

The best way to get the most for your tube steel dollar: *Ask the experts!*

This month's report is on: **2% CR.-MO.**

Has intermediate corrosion resistance in combination with good creep strength and fair resistance to oxidation. For use at temperatures up to 1200°F. in cracking coils, reforming units, heat exchangers, vapor line and hot oil piping, and return-bend forgings for oil heaters.

ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

Carbon	Sicromo 2	Sicromo 5S	18-8Ti
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	16-25-6**

* *Available as seamless tubing on an experimental basis only.*
** *Not available as seamless tubing.*

THERE are probably several high temperature tube steels that will solve your heat, pressure, corrosion or oxidation problems. But there's only one that will give you the most for your tube steel dollar—the best life/cost ratio.

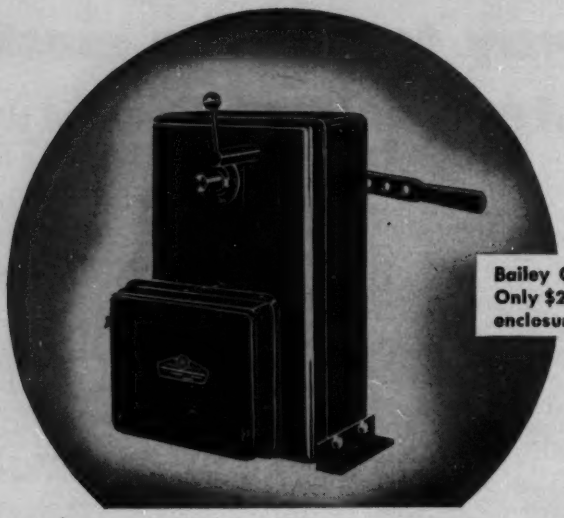
The best way to find it is to ask Timken Company metallurgists. They're recognized authorities on high temperature steels. With 23 years of experience behind them, they can help you select your best steel from 24 different analyses. You'll be sure of getting the most for your tube steel dollar. And you'll be assured of uniform quality in every tube because The Timken Company rigidly controls quality from melt shop through final inspection.

For help with your tube steel problems, *ask the experts!* The Timken Roller Bearing Company, Steel & Tube Division, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This photo shows final tube inspection—last of hundreds of rigid tests that help account for the uniform quality of Timken high temperature steels.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING



Bailey Control Drive, Type AC44P Model 200. Only $210.00 F.O.B. Cleveland, complete with enclosure, positioning relay and hand operator.

Want Better Flow Characteristics from Your Regulating Devices?

This new, small, piston-operated Bailey Control Drive will improve the flow characteristics of butterfly valves, dampers, hydraulic couplings, feeders and similar regulating devices. Adjustment is simple; any desired relation between drive motion and pneumatic signal may be secured.

You can install this compact pneumatic drive power unit in any position on a column, pipe, or flat surface—and connect it to the regulating device with standard Bailey linkage, available from stock.

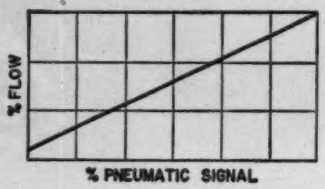
Speed (time required for full travel) is adjustable to suit your requirements. Bailey Control Drives operate on standard SAMA pneumatic signal ranges of 3 - 15 or 3 - 27 psig.

AVAILABLE FROM STOCK in 3 standard sizes

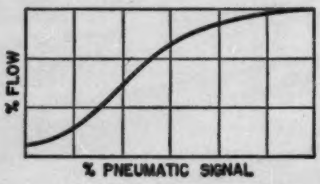
Type	Piston Dia. Inches	Piston Stroke Inches	Torque ft-lb	Max. Travel Degrees	Approx. Dimensions Inches
AC816	8	16	1500	90	13 x 27 x 51
AC68	6	8	400	90	13 x 19 x 34
AC44	4	4	75	75	10 x 11 x 19

P-28

The New Bailey Control Drive gives you THIS—



instead of THIS



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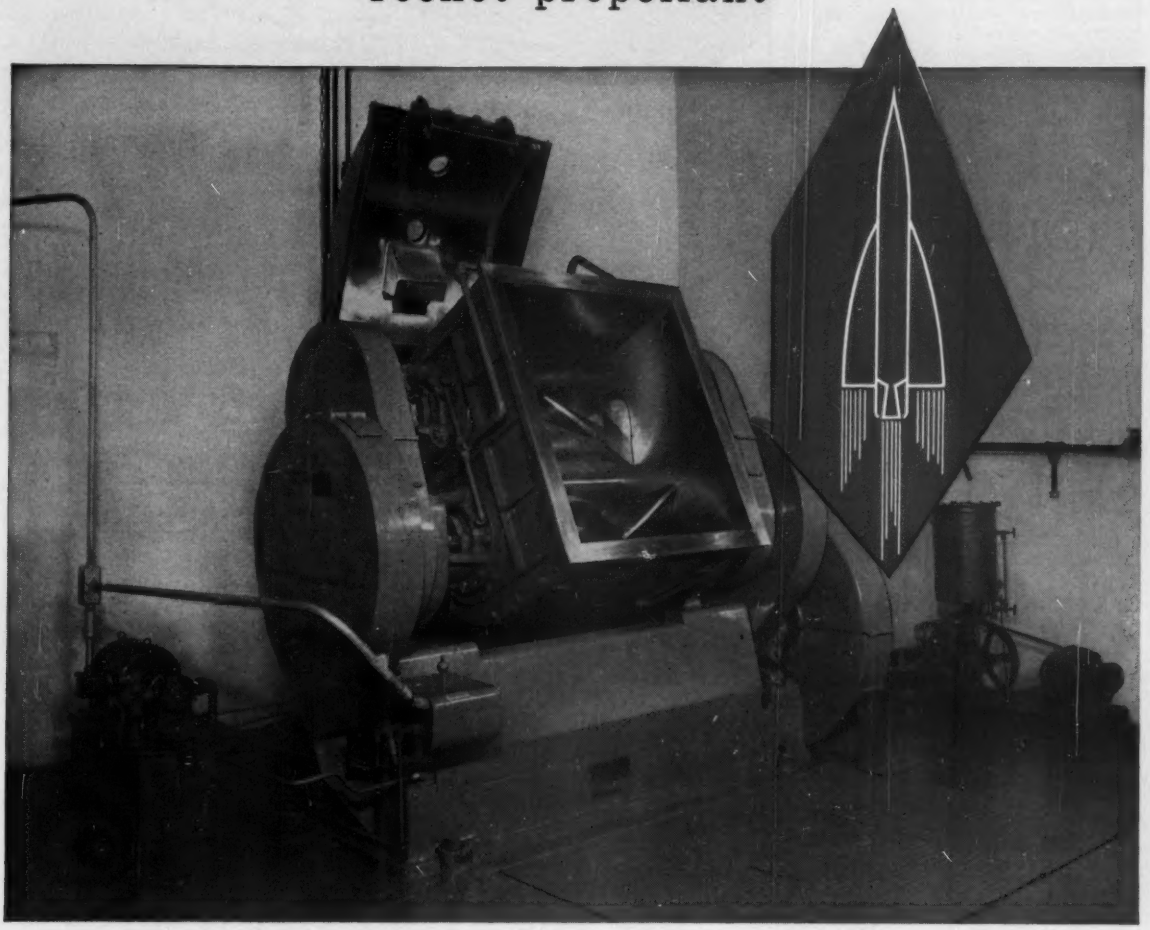
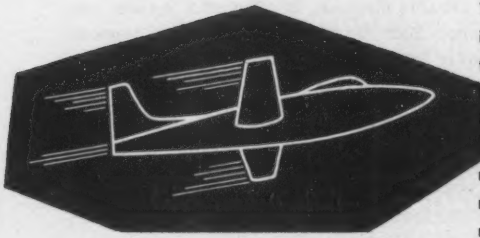
Thiokol® Chemical Corporation selects BAKER PERKINS mixers for processing rocket propellant





The mixing of rocket propellant from new high-energy fuel materials is a sensitive, highly demanding operation. The mixers which do this blending must therefore be not only efficient, but dependable. The Baker Perkins No. 15 Mixer shown here is but one of many in operation in the rocket propellant field. This unit at the Thiokol Chemical Corporation is enclosed in an explosion-proof room of reinforced concrete, and is engineered for complete remote control operation. Powered by a 50 H.P. silent chain drive motor, the No. 15 Mixer is constructed of Stainless Steel, and jacketed to carry 125 psi pressure of steam or water. Its Sigma blades revolve on anti-friction bearings, hydraulic tilt is provided for the mixing chamber, and the vacuum cover is pedestal mounted. Working capacity of this mixer is 100 gallons, and total capacity 150 gallons. If you have a process that calls for a high-performance mixer, write Baker Perkins for complete catalog.

Baker Perkins Inc.

Chemical Machinery Division
Saginaw, Michigan

333

Clarity Measurements in Filtration

by Paul W. Leppla, *Technical Director*

Filtration efficiency is usually measured in terms of flowrate and clarity. Flowrate is readily measured in most plants; however, clarity measurements involve the most difficult aspects of filtration technology. Consequently most industries rely upon visual evaluation of filtrate clarity, which is only semi-quantitative at best and occasionally is purely subjective.

Critical evaluation of filtrate clarity requires instrumental measurement. A number of satisfactory instruments of U.S. manufacture are available. Some measure transmitted light, a questionable technique since few of these instruments discriminate between bleaching of soluble color and the removal of suspended particulates. The measurement of Tyndall or scattered light is much preferred.

Too, the problem of absolute standards is not yet resolved, resulting in confusion on clarity measurements from one laboratory to another. One instrument company has available a series of calibrated standards, which are claimed to be stable, and at least one technical society is working on the development of absolute reference standards so that identical measurements will be possible in different laboratories.

Under these circumstances, evaluating a series of diatomite filteraids is extremely difficult. While Filteraid A may have 90% of the clarification efficiency of Filteraid B in a raw sugar solution, the relative rating in a pectin system may be only 60%. Moreover, the relative clarification of two filteraids with respect to the same liquid may change markedly depending upon the conditions of the test.

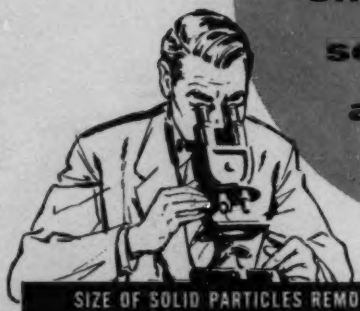
Because of the many variables involved which can influence results to an enormous degree, it is imperative that comparative tests duplicate, as nearly as possible, actual plant conditions. Since often this is difficult, many plants rely on the wealth of experience available to them from a leading supplier in this extremely complex field, experience covering many types of liquors, filters and operating conditions.

The chart in the accompanying advertisement illustrates a significant step forward in this difficult field recently achieved in the Dicalite laboratory. While it is possible to calculate the average pore size of a filter cake, our scientists have known for some time that particles much smaller than the calculated pore diameter are readily retained by diatomite filteraids. By carefully preparing suspensions of uniformly sized particles in the 1-10 micron range, and conducting laboratory filtration tests under carefully controlled conditions, they were able to determine exactly what size particles can be removed by each of the grades of Dicalite filteraids.

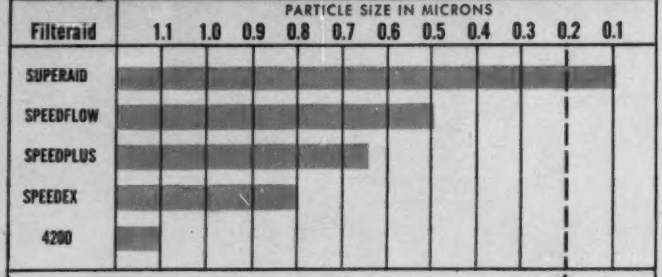
We believe that this type of information, never before published, is important to you, as a user of filteraids.

...With a DICALITE Filteraid

you can filter out particles so small you can't see them with a microscope!



SIZE OF SOLID PARTICLES REMOVED BY DICALITE FILTERAIDS



*0.2 MICRON—Theoretical limit of resolution of optical microscope. Few microscopes achieve it.

80.0 MICRONS—Smallest particle size visible to the unaided eye at 10" distance.

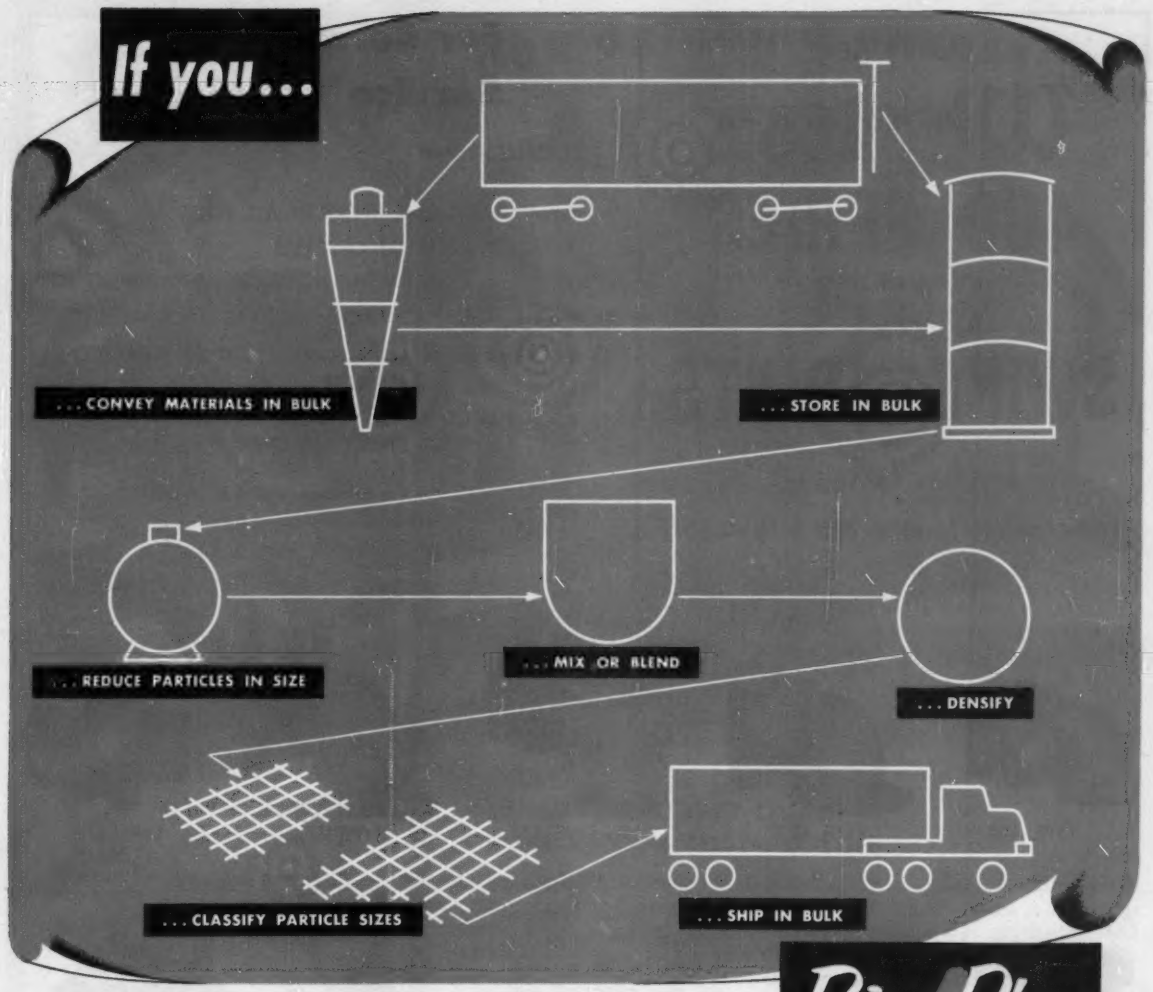
These figures, established in recent Dicalite laboratory tests, are, we believe, the first *accurate* figures ever published on the actual sizes of solids removed by different grades of diatomaceous filteraids. And the dependable uniformity of Dicalite filteraids, in all grades, assures you the same reliable performance, filter run after filter run, on all types of particulates, even gelatinous or slimy. The significance of these figures in pointing the way to the development of maximum filteraid performance can hardly be over-stated. They are one more evidence of Dicalite's leadership in the field of filteraids.

For more complete information on the application of Dicalite Filteraids to your processing problem, write

We Progress thru Service

Dependable GLC GREAT LAKES Dicalite® DIATOMACEOUS MATERIALS

DICALITE DIVISION • GREAT LAKES CARBON CORPORATION
612 SOUTH FLOWER STREET, LOS ANGELES 17, CALIFORNIA



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This success is due to a unique application of engineering know-how and imagination to the solving of difficult processing problems . . . PLUS . . . wide selections of virtually all types of processing equipment ...PLUS...an ability to "adaptioneer" machines to meet individual needs...PLUS... manufacturing facilities that include fabricating, machining, custom founding, woodworking, and laboratory testing.

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For Corrosive Service

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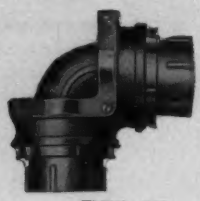
- AVAILABLE IN ANY COMBINATION OF THREADED OR FLANGED CONNECTION
- CAN BE EMPLOYED ON SUCTION OR PRESSURE LINES WITHOUT CHANGING THE PACKING SEALS

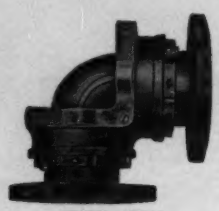
Also available in carbon steel stainless steel, aluminum and malleable iron

TYPE 470

TYPE 470F



TYPE 471



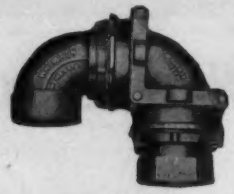
TYPE 471F

TYPE 472

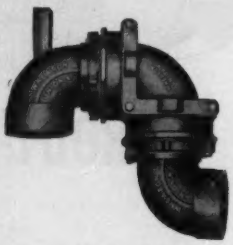
TYPE 472F

TYPE 473

NOTE: Swing joints are furnished with bosses for counter weights on loading arm assemblies and are also available in brass and aluminum. Many combinations of swing joints are available which are not shown both in flanged and threaded connections.



TYPE 474



TYPE 475C

Wheaton Swing Joints can be furnished with seals for any liquid-handling service in the chemical and processing industries. Low maintenance cost is assured by quick, easy packing seal replacement. For complete information call or write for new illustrated catalog.

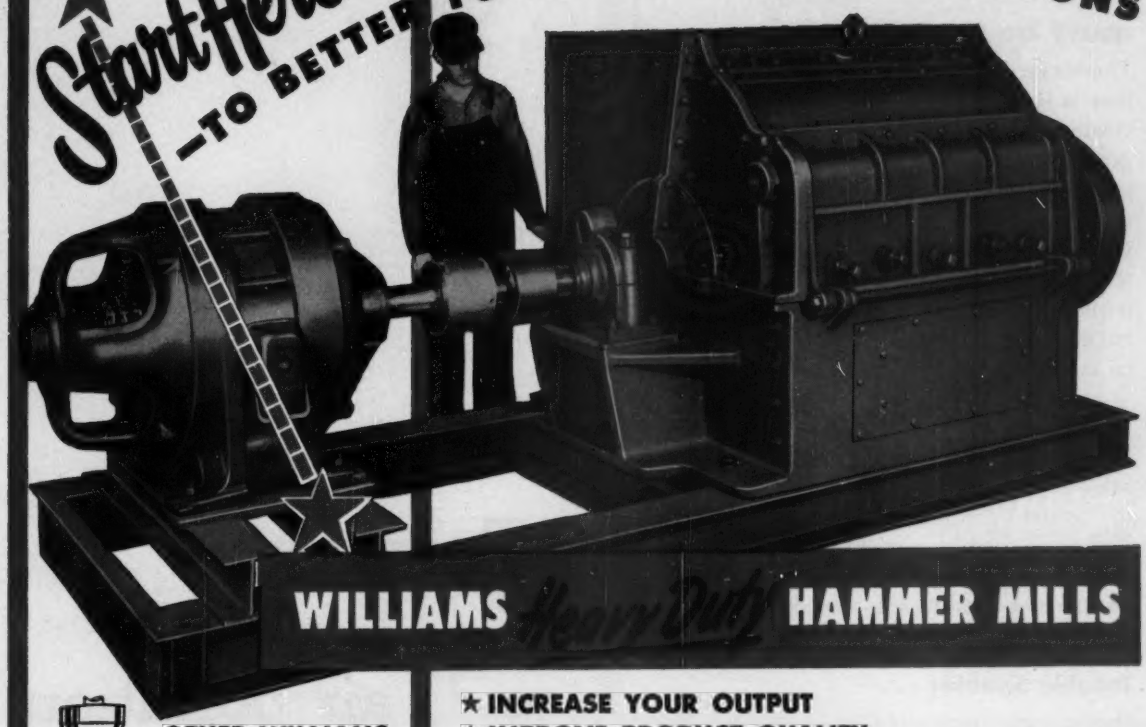
WHEATON BRASS WORKS

UNION, NEW JERSEY

EXCLUSIVE DESIGN SIMPLIFIES MAINTENANCE—

Replacement of the packing seal is exceptionally simple and is quickly accomplished without dismantling the swing joint. It is never necessary to dismantle a loading assembly or piping installation in order to replace a packing seal in these Wheaton Swing Joints.

Start Here —TO BETTER YOUR GRINDING OPERATIONS



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—for fine grinding to 400 mesh or micron sizes

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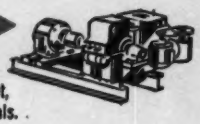
HELIX-SEAL MILLS
—for dust-free grinding, and for wet, sticky, greasy materials.



Also: COMPLETE "Packaged" PLANTS for crushing, grinding, separating.

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★ **IMPROVE PRODUCT QUALITY**
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★ No matter how tough your grinding, crushing or shredding job—no matter what the material; mineral, vegetable, chemical or animal—there's a Williams Hammer Mill engineered especially to get the finished product you want in a single operation—A SAVING UP TO 50% IN PRODUCTION COSTS! Extra primary and secondary crushers are unnecessary—foundations and buildings for additional machines, drives, conveyors and other equipment are eliminated—A SAVING UP TO 75% IN EQUIPMENT COST!

Many Williams exclusive design and construction features assure greater accuracy to meet the most difficult product specifications—and promise continuous satisfactory performance under the most severe operating conditions with an absolute minimum of maintenance.

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CRUSHERS GRINDERS SHREDDERS

OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD

The instrument engineer must be many men

There's no doubt that the instrument engineer is important during the planning and startup stages of an automatically controlled process. During this period he must be a good process design engineer . . . a good control engineer . . . a good supervisor. But . . . we sometimes overlook the fact that, after the new process has finally settled down to normal routine operation, the instrument engineer's job has really just begun. For now he must be a good —

Operating Engineer . . .

Because he has to carefully check the operation of each critical instrument—know how to "tighten" control through careful tuning. If there is need for a change in the type of control, or if an additional instrument must be added he must be able to make the right decisions.

Trouble Shooter . . .

Because instruments are sometimes blamed for the limitations or deficiencies of other equipment. He must be able to diagnose operating difficulties . . . isolate the cause. If the processing equipment is giving trouble he must report it quickly. If the control loop is at fault he must see that it's quickly corrected.

Manager . . .

Because he must keep complete records of instrument maintenance costs. These records will help him select instruments for new projects . . . enable him to decide when existing instruments should be replaced . . . help him in arriving at the correct inventory of spare parts and expendable items.

Know Your Instrument Engineer

He's a key man of automation. Whether you're at the design stage, the specifying stage, the installation stage, or the all-important operating stage, it will pay you to make his acquaintance. He knows instruments and controls. He knows your processes. And he knows how to combine the two to keep your processes "on stream" with maximum economy and minimum down time.

"Enamelstrip" ends air pollution, boosts output 400%

Control for Enamelstrip Corporation's ***Oxycat*** *system is centered on this panel. Included are* ***ElectroniK*** *controllers for temperatures and combustible gas percent, and* ***Protect-O-Vane*** *excess temperature safety cutoff for catalyst bed.*

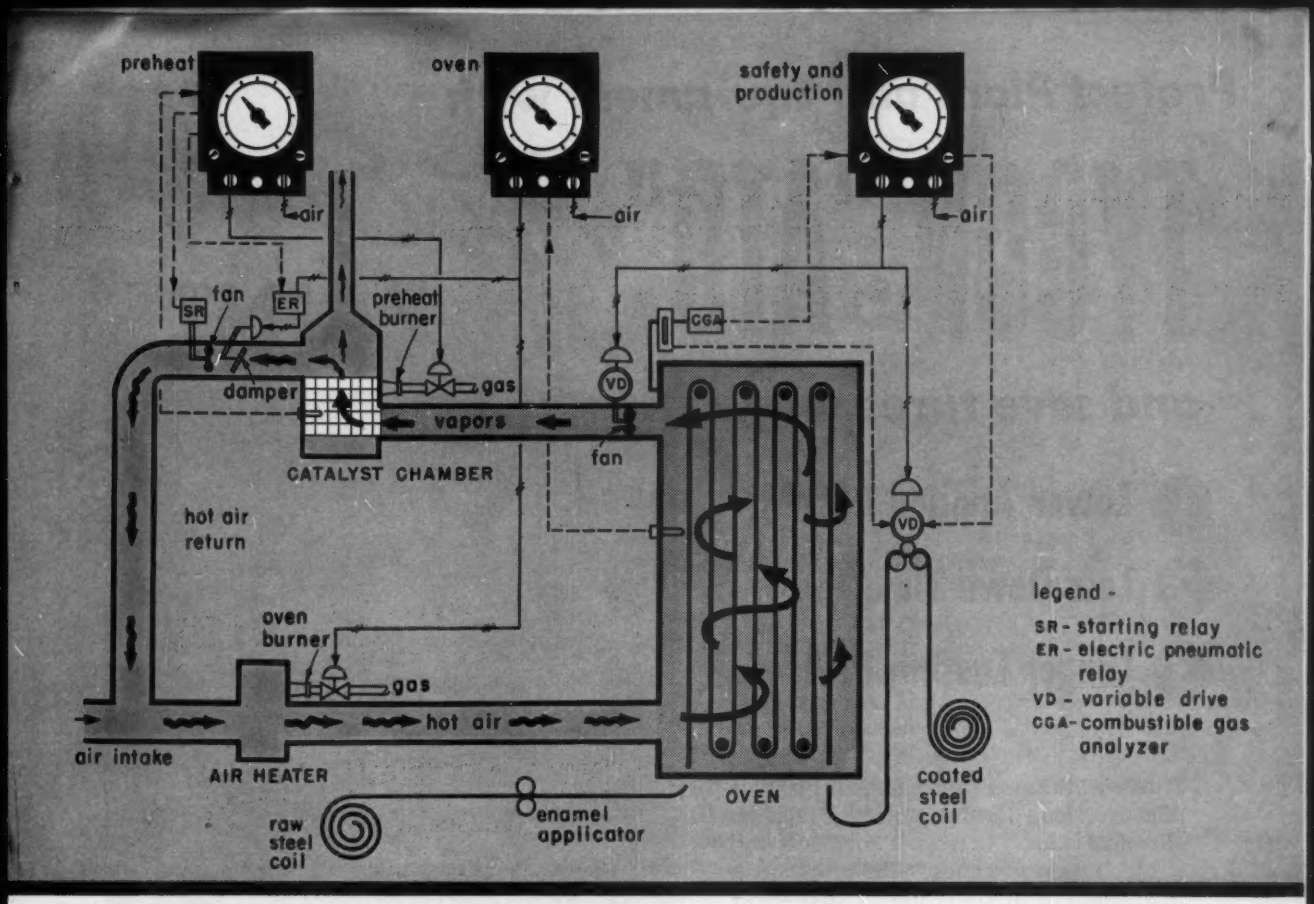

Diagram shows elements of coordinated control for enameling oven and exhaust gas catalytic burner.

. . . using Honeywell controls

PUTTING automatic control to work to solve one problem often pays dividends in unexpected ways. Take the experience of Enamelstrip Corporation, Allentown, Pa. Pungent solvent fumes from their enamel baking ovens created an air pollution problem. With Honeywell engineers, they developed an *ElectroniK*-controlled oxidation catalyst system that turns the pungent solvent fumes into clean, hot gas. The catalyst itself, *Oxycat*, was developed and installed by Oxy-Catalyst, Inc., of Wayne, Pa.

Results have exceeded expectations. Enamelstrip's oven exhaust is 99% pure, and the pollution threat is ended. But this is only part of the success of this installation. So much heat was being generated by the oxidation catalyst that Enamelstrip decided this heat was too valuable to waste. So a second control system, also using *ElectroniK* instrumentation, was designed to recirculate the clean hot gases back to the oven. Results? *Fuel costs for the oven are down 80%.*

And *production has soared 400%* because of a third *ElectroniK*-equipped control system. This instrument continuously records concentration of combustible gases in the oven and automatically adjusts production rates to keep output at its peak safe value.

Finally, Enamelstrip's coordinated control system does such a thorough job of balancing safety against production that the firm's insurance rates have tumbled from $1.25 to less than $0.06 per thousand, a *drop of more than 95%.*

Thus Enamelstrip has recaptured its original $30,000 anti-pollution investment on *each* of three counts: fuel savings, production increase, and insurance rebate.

Want to know what modern control techniques, using versatile Honeywell instrumentation, can do for your own process? Call a Honeywell sales engineer for a consultation . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division,* Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

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First in Controls

Protect Plant and Equipment with

TYGON "ATD" *Hot Spray* PAINT

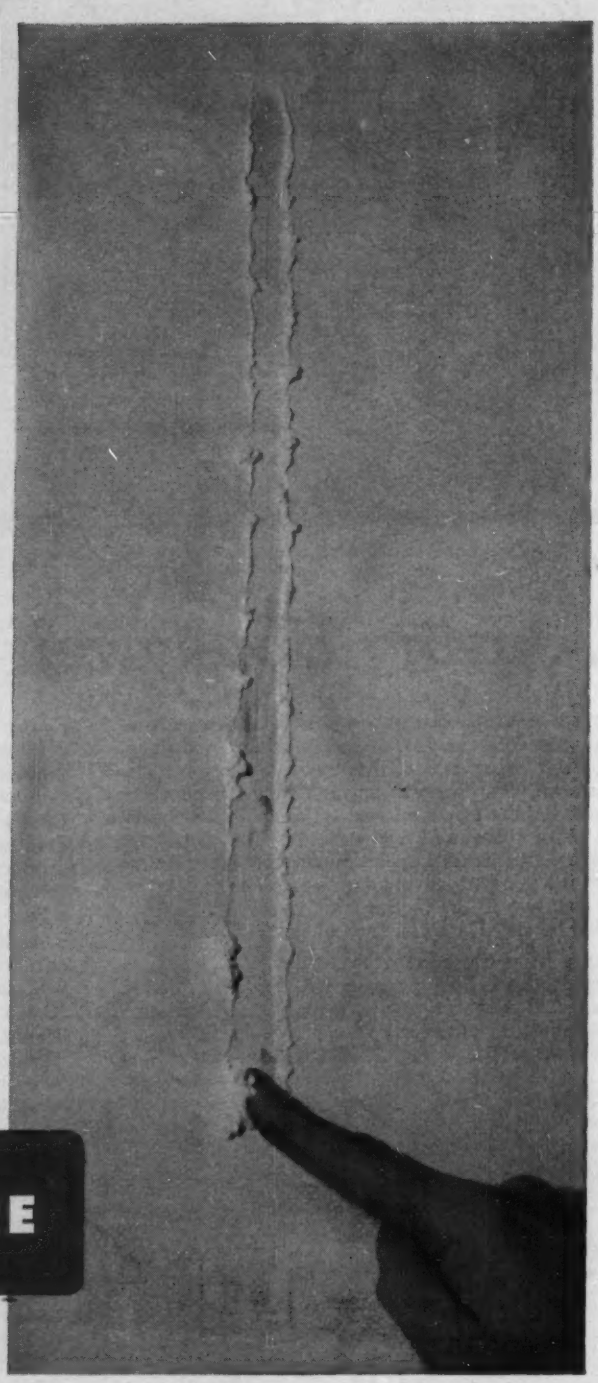
and save three ways:

1. **Lower Applied Cost**
2. **Less Down Time**
3. **Longer Lasting Protection**

It takes thickness in a paint film to give effective, long lasting protection against chemical attack. Corrosion engineers call it the "magic five mils." But to obtain a 5 mil film with conventional cold spray paints means four to five coats, with eight to ten hours drying time between.

But Tygon "ATD" Hot Spray builds the magic five mils in just two slow passes of the spray gun. Labor costs are cut 20%-30%. Down time is held to a minimum. And you get all of the protection against corrosive attack for which Tygon plastic is famous.

Write for the
TYGON COATING MANUAL
This "just-off-the-press" manual is filled with data to make your battle against corrosion easier.



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√ Cellulose molecules are modified for long term preservation in a new process developed by National Cylinder Gas. Treatment with a water solution of an undisclosed copper compound does the trick.

√ You can beam gamma rays of high intensity by aligning nuclei of radioactive materials at near absolute zero. Bureau of Standards researchers discovered the method.

√ High-iron bauxites and red mud wastes from the Bayer alumina process can be smelted in an electric furnace to produce a low-titanium iron and a slag from which aluminum and titanium values are recoverable by sulfuric acid treatment. Strategic Metals Corp. is working with a major aluminum producer on application of this process.

Reactor error may spur "A" insurance

The Atomic Energy Commission recently revealed that an operator's error allowed one of its nuclear reactors to get out of hand last fall, melting the reactor core and releasing radioactivity into the building.

The reactor that went haywire was just a small, experimental facility at the national testing station near Arco, Idaho. And while AEC's veil of secrecy shrouds details of the incident, the accident underscores testimony that some sort of government liability insurance plan must be developed before the nuclear industry will grow.

Recent Congressional hearings saw some of the biggest names in the atomic program exhibit a reluctance to spend too many more millions of their stockholders' dollars without the assurance that risks will be underwritten.

Private insurance syndicates stand ready to handle reactor risks up to $65 million—far above the $10-million ceiling on a chemical plant, the most risky type of industrial facility up to now. But since operating experience with nuclear reactors is so limited, and since everyone involved in a reactor catastrophe, from suppliers of parts to the operator, could be sued in an accident, atomic pioneers say $65 million isn't enough. Billion-dollar damage claims from a single accident could wipe out even the biggest firms in the land.

So Congress is under pressure to set up a government program to cover risks not insured by private carriers, at least until private firms get enough operating experience. Two bills have already been introduced. And perhaps more than all other entreaties, the Arco incident may spur a favorable vote on one of these bills this session.

Stronger federal pollution law likely

A broader, slightly stronger, "permanent" federal water pollution control law, generally acceptable to chemical industry man-

agement, is well on the way to enactment.

The new law still would require the U. S. Surgeon General—who would enforce it—to give state pollution abatement officials every opportunity to compel firms or towns to curb pollution. But if the state fails to act effectively and interstate waterways are involved, the federal government could then step in without consent of the offending state.

Though chemical makers drew praise in hearings on the bill for their efforts to treat plant wastes, they are concerned with one feature of the new bill. Unlike the present law, it has no airtight provision requiring federal judges to be guided by "the physical and economic feasibility" of proposed abatement measures before ordering industry to undertake them.

Ion exchange faces strong threat

Don't jump to the conclusion when you read the stories in this issue on uranium processing (pp. 124-132) that liquid-liquid extraction will continue to play second fiddle to ion exchange as a way to separate metals.

Right now, ion exchange holds the advantage—at least in the uranium raw materials program—of a several-year head start. But solvent (liquid-liquid) extraction is ticketed for a big boost in uranium processing. It is also getting serious scrutiny for a new commercial plant to separate tantalum from columbium. And the Geneva Atoms-for-Peace Conference brought to light the fact that solvent extraction is the key to production of hafnium-free zirconium **(see below)**.

Ion exchange got the jump on solvent extraction in uranium processing because it was relatively easy to blow up laboratory results to plant-scale design. Extraction researchers, meanwhile, have spent long months looking for suitable solvents and working on ways to mix and separate the phases most effectively.

Most promising of the solvents turned up are dodecyl phosphoric acid, 2-ethyl hexyl phosphoric acid and several secondary amines. (Among the latter is a Rohm & Haas product designated 9D178.) These solvents are especially suited for the sulfuric acid-leach system used with Western U. S. uranium ores, as opposed to the pyrophosphate esters used for processing phosphoric acid made from Florida phosphate rock (p. 130).

Ready to take advantage of extraction's low-cost, continuous operation are Kerr-McGee at Shiprock, N. M., and Vitro Uranium Co. at Salt Lake City. Both firms have put the technique through pilot-plant stages, should soon announce full-scale plants.

Whether or not solvent extraction will supplant ion exchange for uranium processing is problematical. Extraction works well on clear liquors and dilute slurries; it can't be used with pulps. Ion exchange, on the other hand, can be used on pulps via the recently developed resin-in-pulp technique. (Some operators are criticizing the RIP method, however, on the basis that it makes vanadium recovery from tailings impossible.)

According to a spokesman for National Lead, neither process has a clear-cut edge. The company is working with both processes at AEC's raw materials development laboratory in Winchester, Mass., and ore testing pilot plant in Grand Junction, Colo., has just taken over operation of a uranium processing mill at Monticello, Utah.

Besides, the many ion exchange plants now in operation won't change over to solvent extraction unless they can realize a significant cost advantage. Possibly these plants will add solvent extraction as an adjunct to ion exchange.

But solvent extraction boosters, both inside and outside AEC, think that most new plants for processing natural uranium will use the extraction route. And it's certain to be used for tapping the next big source of uranium—lignite. Presence of molybdenum plays hob with ion exchange when processing lignite for its uranium content.

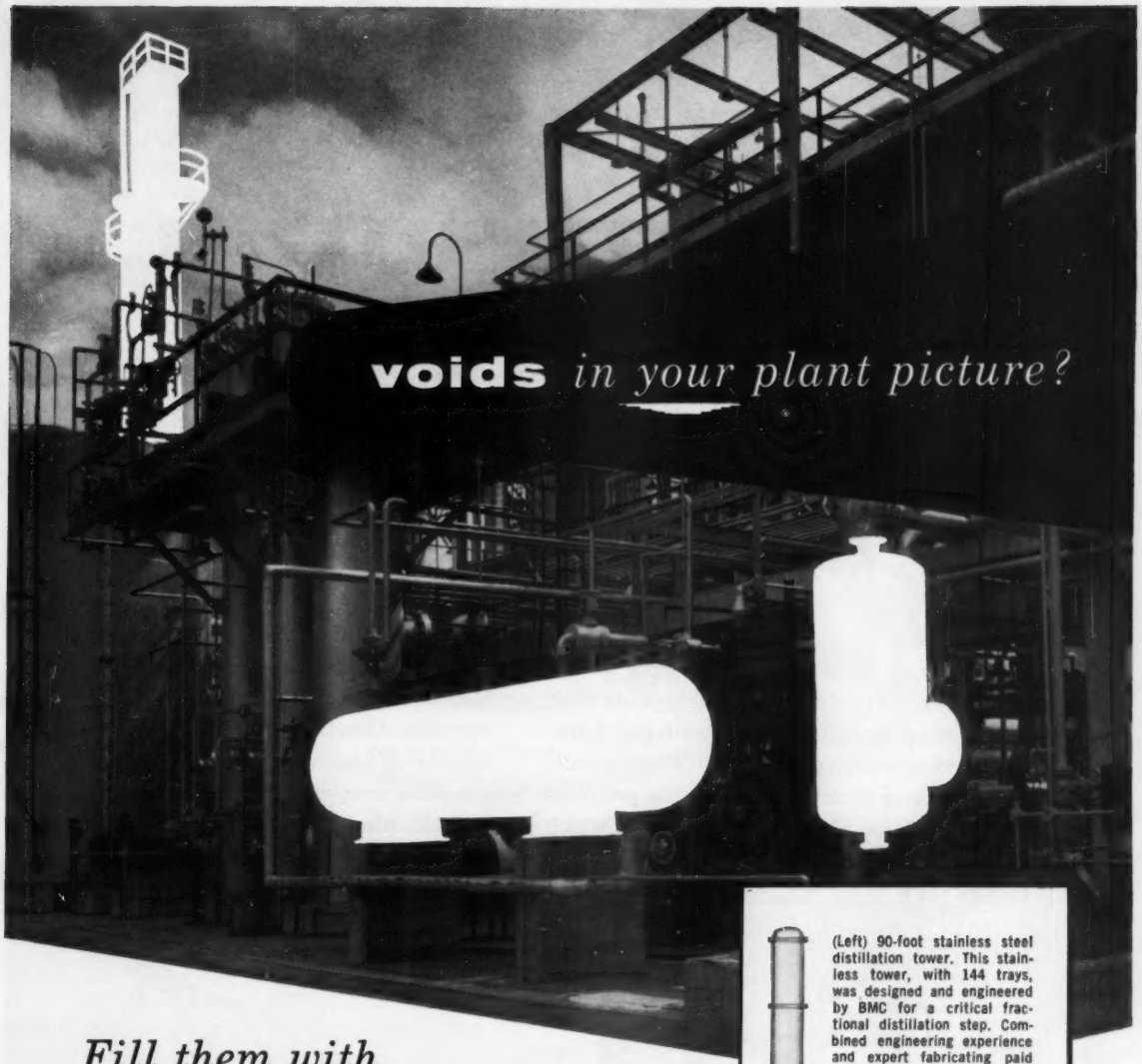
Solvent extraction separates metals

Processing of uranium ores isn't the only metallurgical application of liquid-liquid extraction to emerge recently.

Fansteel Metallurgical Corp., Chicago, has just completed a pilot plant for liquid-liquid extraction of tantalum-columbium mixtures. If the process looks good on the small scale, Fansteel might use it in a big new plant now under consideration.

This extraction process involves use of ketones and other organics on a mixture of the semirefined fluorides of the two metals. Process was worked out on laboratory scale

(Continued on page 108)



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BMC Process Equipment

New installation? . . plant expansion? . . modernization?

Whatever the reason you require process equipment — from a single boiling cap to a huge tower — BMC can supply it on *time*, on *quotation*, on *specification*.

Shop facilities and technical skill are available for building and testing the equipment you need . . . from whatever metal is required . . . in virtually any size . . . to any degree of complexity.

BMC experience costs no more. And you have the added assurance that your equipment is fabricated to the highest technological standards. What better reasons for inviting BMC to bid on your next project?

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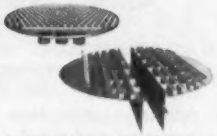
(Left) 90-foot stainless steel distillation tower. This stainless tower, with 144 trays, was designed and engineered by BMC for a critical fractional distillation step. Combined engineering experience and expert fabricating paid off for this customer — as it can for you.

A 2000-square foot vapor condenser for alcohol purification. Engineered and fabricated to close tolerances — typical of the type of job BMC has a reputation for doing right!

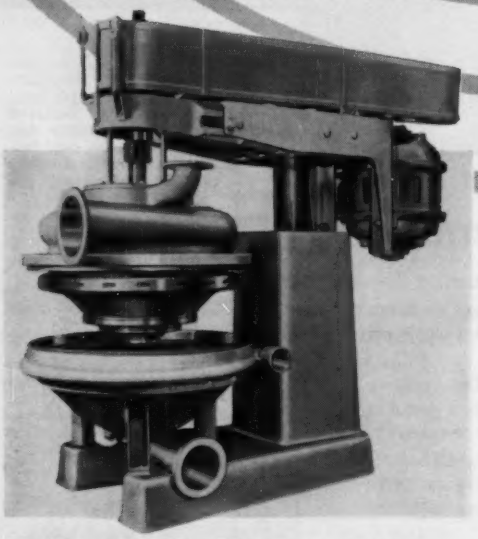


BMC has long been closely identified with fractionating tray design, development and manufacturing. Single unit or a carload, bring your tray problems where they'll get expert solutions.

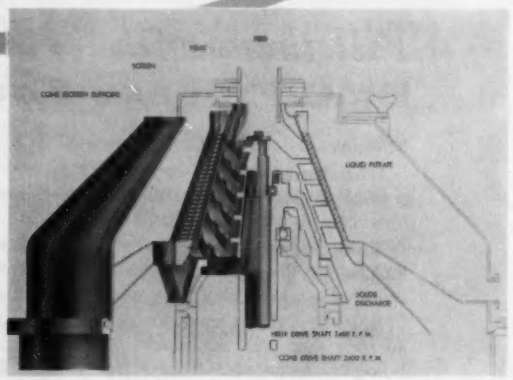
CENTRIFUGAL FORCE . . .

Important Tool for the Process Industries

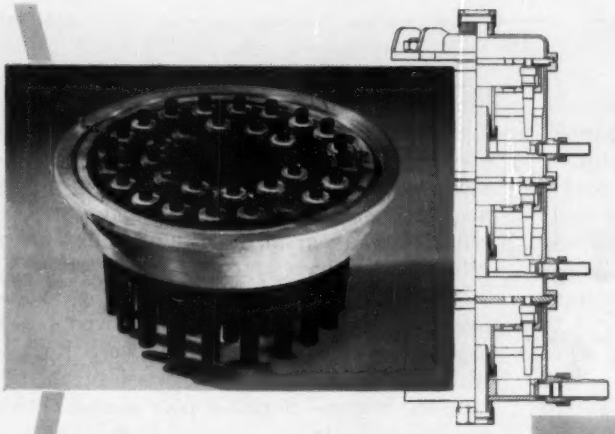
Continuous processing requirements in the Chemical Industries have placed an ever increasing emphasis on centrifugal force. Rounding out an existing line of equipment, Dorr-Oliver is now marketing the products of the Merco Centrifugal Company which was consolidated with Dorr-Oliver on February 1st of this year. The tried and tested Merco Centrifugal Separator and the new Mercone Centrifugal Screen can now be teamed up with a wide variety of DorrClone Classifier designs to meet any wet processing problem where the use of centrifugal force is indicated.



The Merco Centrifugal Separator . . . a continuous, versatile centrifuge for microscopic particle segregation down to 1 micron, for washing and concentration or for soluble recovery. Features built-in hydraulic hoist, overhead bearing and stainless steel rotor and housing. Bulletin No. 4051.

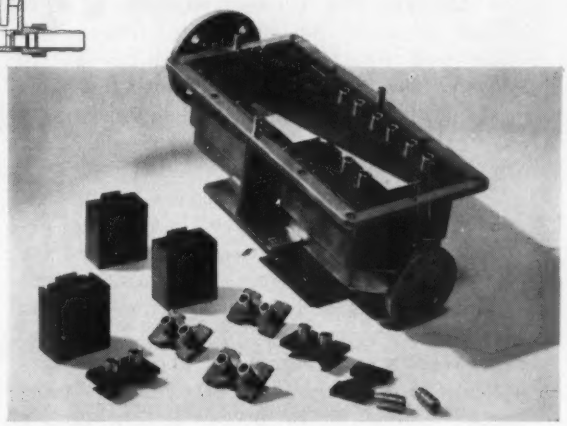


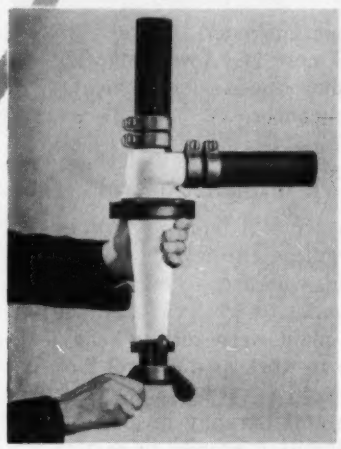
The Mercone Centrifugal Screen . . . a new unit combining the outstanding features of a centrifuge and a screen. Operation is completely continuous permitting large throughput capacity. Cyclo drive operates screen and helix at positive differential speeds . . . solids are conveyed along the screen and discharged in a dry state. Bulletin No. 1555.



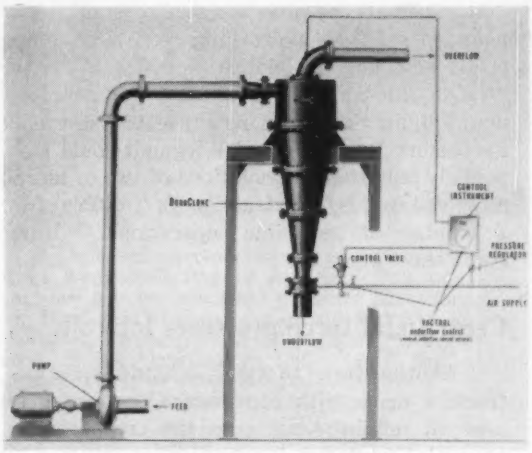
The TM DorrClone . . . combines number of 10 or 15 mm dia. cyclones in a common housing with all cyclones in each stage operating in parallel. Up to three stages can be incorporated in a single unit for separations in the order of 2-3 microns. Bulletin No. 2502.

The M DorrClone . . . Combines molded rubber block cyclones in diameters of 30 and 50 mm installed in a common housing. Type M-30 (containing twenty 30 mm dia. units — illustrated at right) separates at 8-10 microns and Type M-50 (containing ten 50 mm dia. units) at 15-20 microns. Bulletin No. 2504.





The P-50 DorrClone . . . a 50 mm dia. wet cyclone constructed entirely of porcelain. Capacities vary from 7.5 GPM at a feed pressure of 7.5 psi up to 30 GPM at 80 psi. Leaflet No. 2505.



The FR DorrClone . . . a completely rubber lined wet cyclone in diameters of 6″, 12″ and 24″. Features a fixed feed opening and varying vortex finder and apex openings. Capacities vary from a lower limit of 50 GPM for the 6″ unit to 1550 GPM for the 24″ unit. Average separations range from 25 microns in the 6″ to 60 microns in the 24″. Bulletin No. 2503.

Illustrated on these pages are several of the designs Dorr-Oliver has used to harness centrifugal force for the process industries. Only by carefully analyzing the problem can the correct unit specifications be determined. Any or all of the bulletins listed are free on request. When writing we suggest you include a brief outline of the particular application you have in mind. Dorr-Oliver Incorporated, Stamford, Connecticut.

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by the Bureau of Mines. Present process used by Fansteel involves fractional crystallization.

AEC's long-secret zirconium-hafnium separation process has recently been identified as solvent extraction. In the system used, hafnium thiocyanate is extracted preferentially in a hexone-thiocyanic acid mixture from an aqueous solution containing zirconium and hafnium.

Carbide and Carbon workers at Oak Ridge get credit for devising the process. It was used by the Bureau of Mines at its Albany, Ore., zirconium plant until the plant shut down last summer; it is being used now by Carborundum Metals Corp. at Akron, N. Y., to produce hafnium-free zirconium.

Other information released within the past few months has spotted liquid-liquid extraction steps in the process flowsheets for converting uranium ore concentrates into uranium metal and for recovering uranium from spent nuclear reactor fuel.

What's most significant about these applications of liquid-liquid extraction to processing of metallic compounds is that, until a few years ago, extraction was applied almost exclusively to the processing of organic compounds, such as petroleum, vegetable oils, acetic acid and antibiotics.

At the time of CE's feature report on liquid-liquid extraction in June 1952, Cornell Professors Von Berg and Wiegandt could say publicly only that, for solutions of two or more dissolved solids, "Extraction is feasible for a number of inorganic separations." How right they were!

Centrifugal force processes lube oils

Another trend to watch in liquid-liquid extraction deals with conventional processes—lube oil refining—but puts the emphasis on improved contacting equipment.

Podbielniak, Inc., Chicago manufacturer of continuous centrifugal contactors, has granted M. W. Kellogg Co. a limited license to incorporate the Podbielniak machine into Kellogg-designed plants for refining lube oils via phenol extraction. Right now, Kellogg is designing such a unit for Petroleo Brasiliero S. A., the Brazilian government's petroleum agency. This unit will use three "Pod" extractors, each 36 in. dia. by 36 in. wide, instead of the usual towers.

Kellogg has put one of these machines through its paces at the Deep Rock refinery of Kerr-McGee Oil Industries, Cushing, Okla. Results of these tests sold Kellogg engineers on the advantages of the centrifugal contactor. In addition to operating savings, the machine can save its own cost, and more, by reducing the capital tied up in expensive solvent inventory.

Interesting angle is that Kellogg engineers freely admit that the improved tower design they recently put in at Deep Rock—which they feel is the last word in phenol-treating towers—is now a poor second choice for future units.

Other refiners known to be actively working with Podbielniak extractors include Sun and Texaco. Sun has had two machines in operation for several years at Marcus Hook, Pa., in furfural treating of lube oils. Texaco has experimented with a Pod extractor at Port Arthur, Tex.

Although neither company is ready to reveal operating data now, look for significant announcements about these developments within the next few months.

GLPC goes to work in plant control

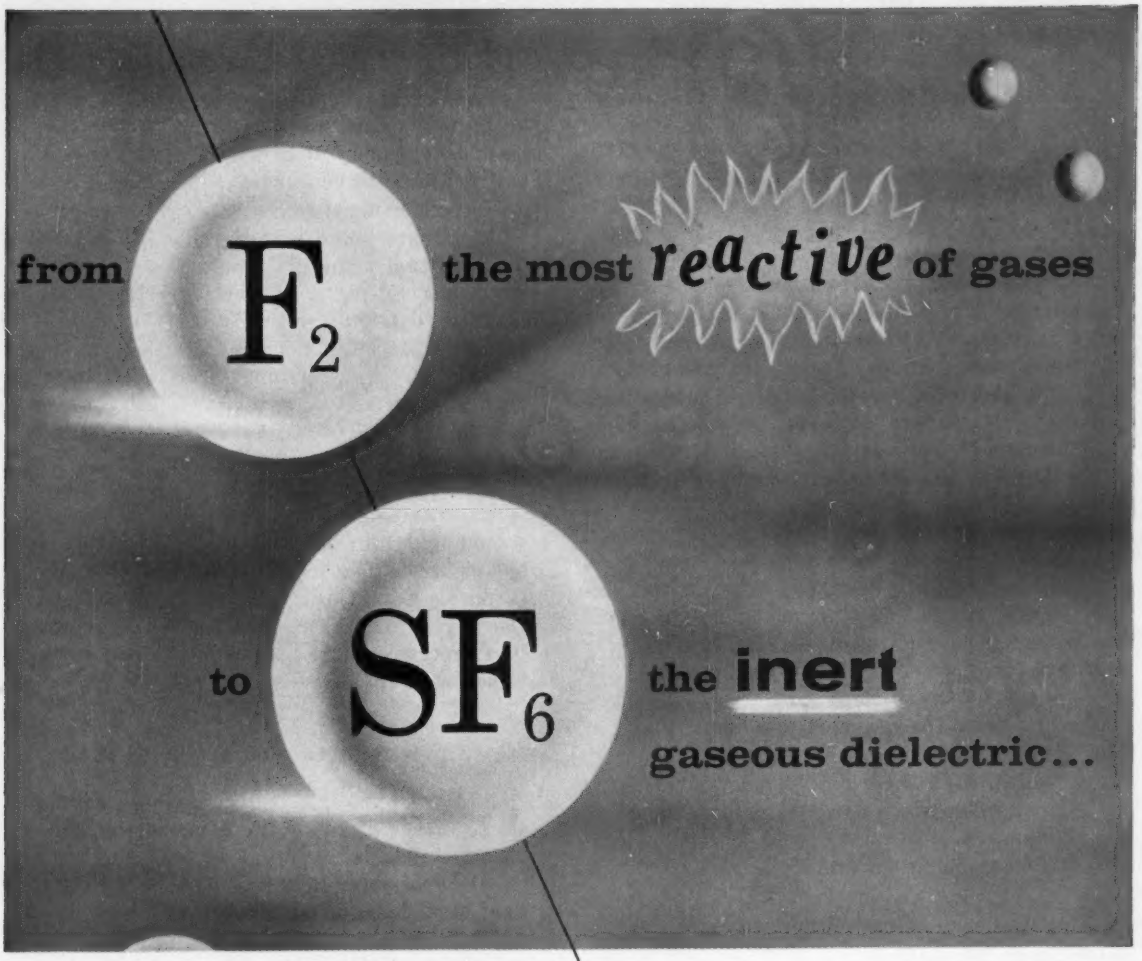
While chemists were listening to some 19 papers on vapor-phase chromatography a few days ago at the American Chemical Society meeting in Dallas, engineers at Shell Chemical's Houston plant were getting ready to put this principle to work as a control tool on the production line.

Vapor-phase chromatography in general, and the gas-liquid partition process in particular, is the number one interest right now of scores of analytical chemists and instrumentation engineers throughout the chemical process industries. The chemists have been the first to benefit from these recently developed techniques.

Shell Chemical, until now, has used gas-liquid partition chromatography to supplement existing analytical methods at its Martinez, Dominguez and Houston plants. The new installation at Houston will be Shell's first GLPC unit to be used for automatic process stream analysis. In view of Shell Development Co.'s significant contributions to developments in this field, the Houston unit may well be the first GLPC instrument used anywhere for automatic control purposes.

Look for a rundown of what GLPC is all about in our next issue.

(Continued on page 110)



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Acetic acid detour permits epoxidation

With its new process for making peracetic acid, Carbide & Carbon, in the words of President H. B. McClure, will be able to have its cake and eat it too.

Carbide has found a practical way to make peracetic acid from acetaldehyde. When used to effect any desired expoxidation reaction, the peracetic acid ends up as acetic acid. Since huge volumes of acetic acid are made by air oxidation of acetaldehyde, the new process in effect detours some of the acetaldehyde through the peracetic-epoxidation route and still yields about the same amount of acetic acid for sale.

As a basic producer of the simpler epoxides, ethylene oxide and propylene oxide, the company has long been interested in economical syntheses of higher epoxides. Direct oxidation has not been successful. The peracetic acid route will put Carbide into the epoxide business with both feet. To date, more than 375 epoxides have been made at the South Charleston laboratory.

Although these developments are still in the experimental stages, plans for commercial production of peracetic acid and its derivatives are being drawn.

Tonnage oxygen keys carbide process

Calcium carbide and other products now made by electrothermal methods may some day declare their independence from cheap electric power.

A big step in this potential revolution is taking place now in Germany, where Badische Anilin & Soda-Fabrik has reached a scale of 70 tons/day with an experimental oxythermal calcium carbide unit at Ludwigshafen. Coke and lime are charged to a graphite-lined shaft furnace; oxygen reacts with part of the coke to form carbon monoxide and provide the necessary high temperature. Liquid calcium carbide is tapped off periodically.

The oxythermal process offers an additional feature—it can turn out high-concentration carbide. Electric furnace product usually runs less than 83% CaC_2, with lime in excess. Correcting this by adding coke increases the electrical conductivity of the charge and thereby hurts the energy efficiency. This limitation is absent from the oxythermal process.

Competition between electrical heat and combustion heat in chemical and metallurgical processes has seesawed back and forth ever since development of industrial electric power late in the 19th century. During the 1930's one producer made elemental phosphorus in a blast furnace, but electrothermal phosphorus has a virtual monopoly today. On the other hand, electric pig iron processes have found little use outside of Scandinavia.

New factor in today's technology is the availability of cheap tonnage oxygen. Only with oxygen can a combustion process for calcium carbide reach the 2,500 C. temperature needed.

According to BASF, economic evaluation of oxythermal calcium carbide manufacture should take into account the value of the almost pure carbon monoxide off-gas from the furnace. From this angle, you might consider the oxythermal process simply as a gasification process in which calcium carbide is obtained as a valuable slag.

Hydrogen reduces iron ore in fluid bed

The fluidized-solids technique is getting set to invade a potentially tremendous field—the steel industry.

Hydrocarbon Research, Inc., and Bethlehem Steel have jointly developed a new iron-making process in which iron ore fines are reduced by hydrogen in a fluidized bed. Iron oxide is charged as a powder; iron leaves the reactor also as a powder, of the same particle size as the charge. Product is compacted into chips by mechanical pressure.

Typical operating conditions are 900 F. and 400 psi. Water vapor formed in the process is removed by cooling the circulating hydrogen stream to 100 F.

Process economics depend on availability of cheap hydrogen. HRI figures on getting hydrogen via partial oxidation of any convenient fuel. Cost of hydrogen per ton of iron, says HRI, will be less than the cost of equivalent coke used in a blast furnace.

Right now HRI is busy putting together cost estimates for various sizes of commercial plants. One attractive feature of the new process is that the minimum economic size is much smaller than that of a blast furnace. This minimum size could possibly be as small as the experimental unit at Trenton, N. J., which has a reactor 34 in. I.D. by 30 ft. high.

For more of WHAT'S HAPPENING . . . 113

Everybody's doing it . . . with aluminum

Strategic industrial material, aluminum has a bright future in the rapidly expanding do-it-yourself market. Every day, new uses are found for this versatile metal that account for increased demand for soda ash, caustic soda, and sulphuric acid . . . chemicals essential to aluminum production.

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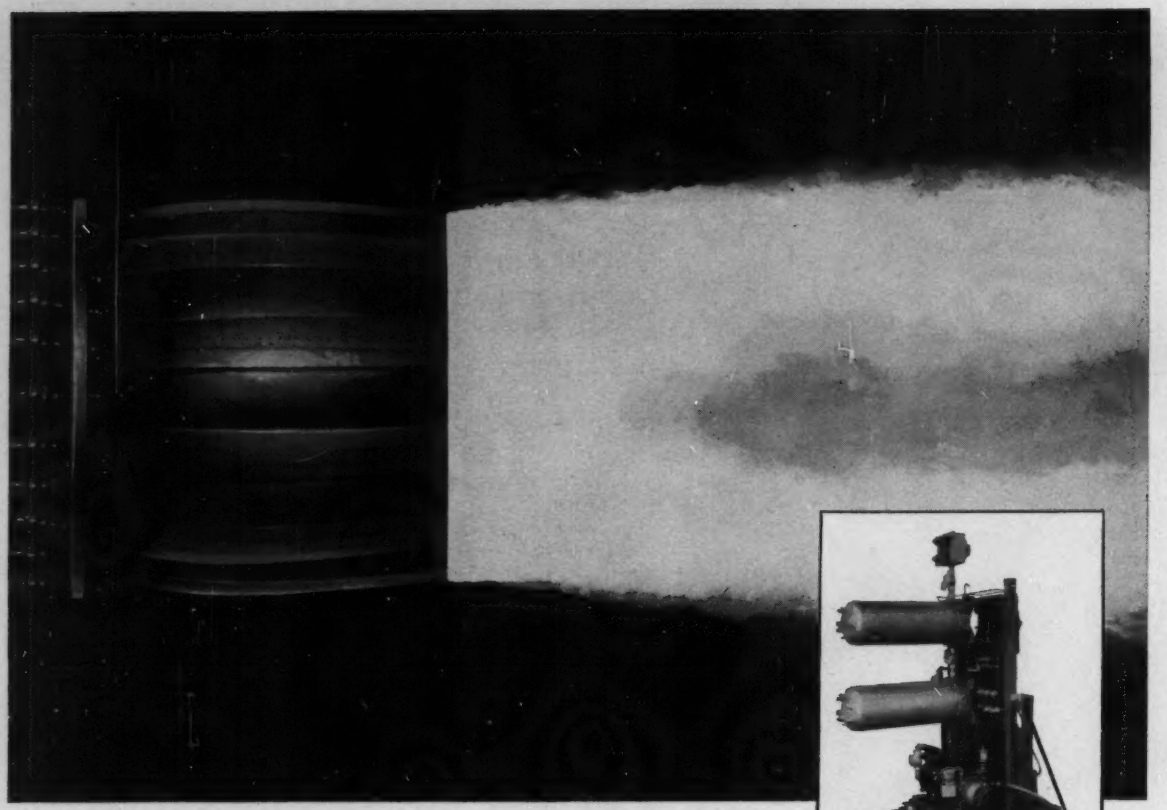

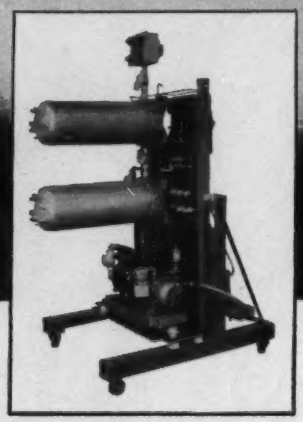

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Tests jet afterburner components

In test set-ups on jet afterburner components, Pratt & Whitney Aircraft uses a P-E TRI-NON® continuous infrared analyzer to run a differential analysis on exhaust gases before and after fuel injection in the afterburner. This is accomplished by means of a reference probe in the gas stream before fuel injection, and a movable probe in the stream after injection. The probes move in a set pattern, and differential readings are made at many points in the gas stream. Results indicate the distribution of fuel as it is injected into the afterburner, and tell the test engineer:

(1) whether efficient burning is being accomplished.
(2) whether heat distribution is uniform, so that local overheating of metal is avoided.

The Tri-Non time constant of less than a second permits an overall system response of 30 seconds per reading with an accuracy of ±1%.

This type of application for the TRI-NON Analyzer has possibilities in industries other than aircraft. Automobile designers working with cascaded systems, oil companies doing fuel and combustion research, and chemical engineering groups have shown considerable interest.

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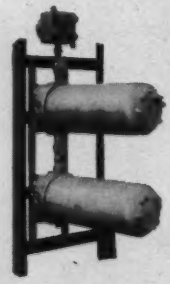

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P-E TRI-NON Analyzers are available in a wide range of models and prices to meet all types of continuous analytical problems. They are rugged and dependable, expressly designed for use in the varied environments of a processing plant or refinery. For quick and easy maintenance, instrument components can be tested right on stream — without disconnecting.

What's Happening

MAY 1956 FEATURE NEWS

- **Dry Ice From a New Source** 114
  Westvaco captures high-grade byproduct CO_2 from manufacture of industrial phosphates, turns it into dry ice in a compact, low-cost plant.

- **Three Entries Swell Isocyanates Field** 116
  New Du Pont, Mobay, National Aniline plants get large-scale production of isocyanates off to a thundering start.

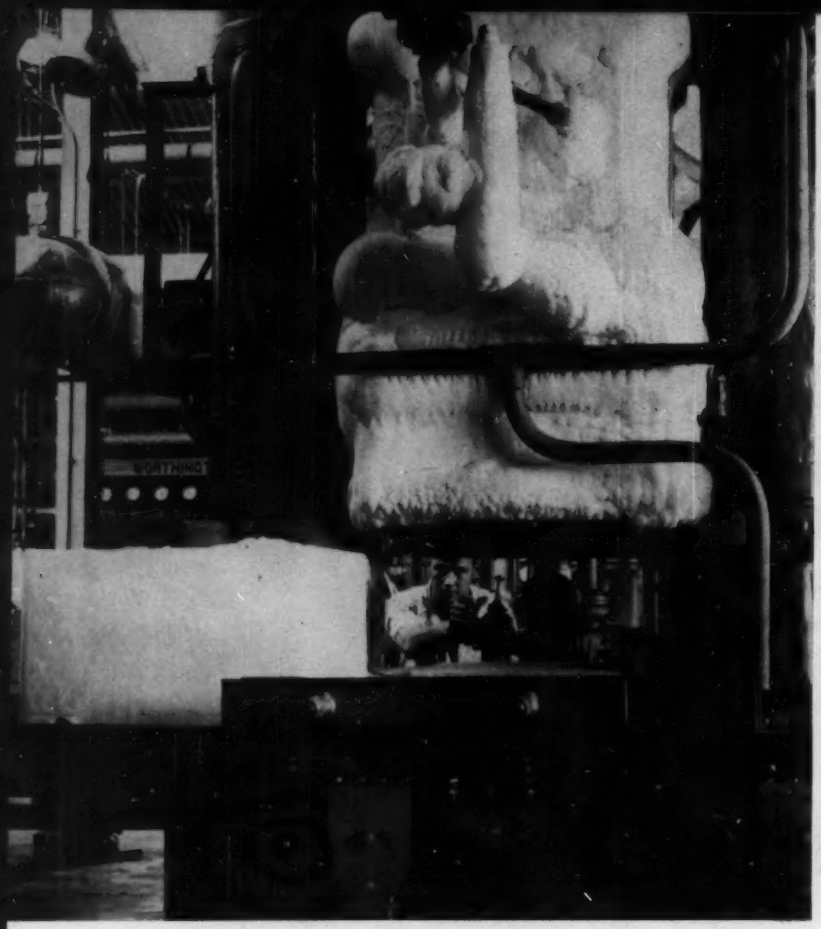
- **Do It Yourself in Small Mercury Cells** 118
  New "packaged" low-amperage cell is tailored for the small chlorine-caustic user. Unique cathode design is outstanding engineering feature.

- **Ion Exchange Strikes It Rich** 124
  Recovery of uranium from ores or waste slimes is now biggest use outside of water-treatment field.

- **Acid-Leaching Demands Careful Design** 126
  Protection against corrosive conditions has paid off in pioneer uranium-from-gold-slimes plant.

- **Solvent Extraction Problems Overcome** 130
  Here's how smart chemical engineering put uranium recovery from phosphate rock on sound basis.

- **Convention Calendar** 116



Three big presses like this are now turning out . . .

Dry Ice From a New Source

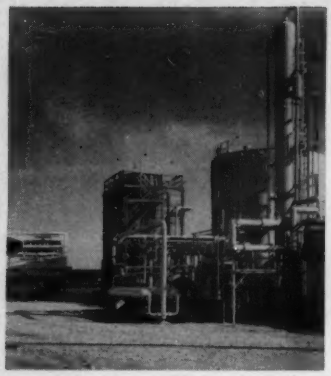
Westvaco captures high-grade byproduct CO_2 from manufacture of industrial phosphates, turns it into dry ice in a compact, low-cost plant.

Dry ice is now a coproduct of sodium phosphates. By solidifying the carbon dioxide turned loose in continuous neutralization of phosphoric acid with soda ash at its Lawrence, Kan., plant, Westvaco Mineral Products, a division of Food Machinery & Chemical Corp., stakes its claim as first to travel this route to dry ice.

Westvaco has also staked its claim to a big share of the growing dry ice market in the Kansas City area. On stream since last June, the new unit can turn out as much as 60 tons/day of dry ice.

▶ **% High, $ Low**—An installation of this capacity utilizing the usual low-concentration sources of CO_2 (e.g., lime kiln or boiler flue gas) would cost around $1.5 million, says Howard Sommers, chief engineer of FMC's chemical divisions. But with high-concentration gas directly available from the phosphate plant, Westvaco cut the initial investment to half this figure.

Operating success of this unique combination centers on the phosphate plant's ability to supply CO_2 continuously to the ice plant. Neutralization of the phosphoric acid in the five-year-old phosphate plant, elsewhere a batch operation, has been put on a continuous basis in order to obtain a steady flow of by-product gas.



CONTINUOUS reaction in phosphate plant is key to success.

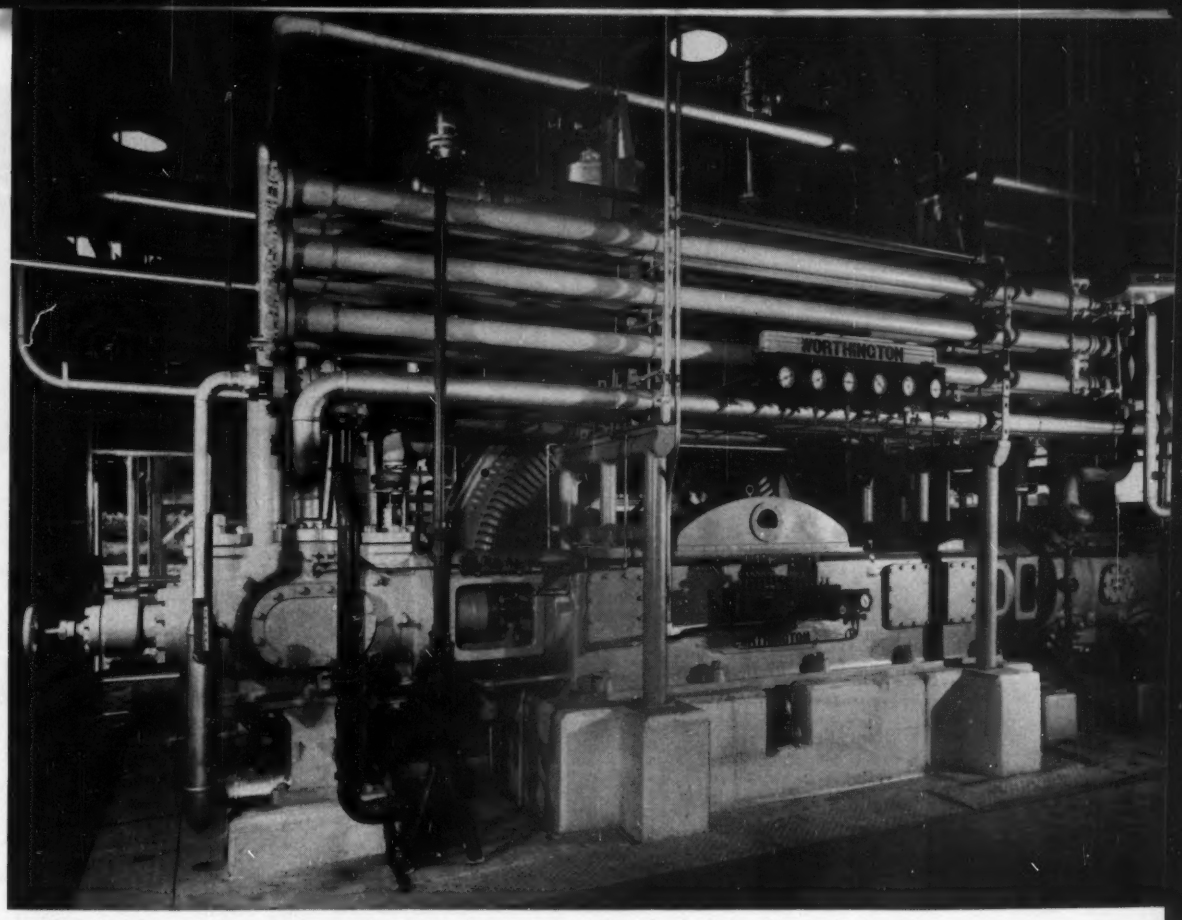
▶ **Westvaco's Design Philosophy**—Sommers, with 25 years of dry-ice experience, guided design of the new plant along the concept that economy of large units of equipment outweighs operating security of smaller multiple units. High operational reliability of modern, well designed process equipment, he feels, reduces to an ignorable minimum the risk of production shutdown, the difficulty of machinery maintenance that would result from breakdown of a large single unit.

Examples of this philosophy previously applied: Westvaco's 36,000-kw. elemental phosphorus furnace at Pocatello, Idaho; its single 2,500-hp. synthesis-gas compressor, 400-hp. circulator and 400-hp. air compressor at the Charleston, W. Va., ammonia plant.

Examples applied to the Lawrence dry ice plant:

- Choice of compressor—a single four-stage, 700-hp. machine instead of the two half-size or two-thirds-size units usually used.
- Choice of ice presses—three of the largest standard units available, each delivering 250 tons pressure. Each press can turn out two hundred 250-lb. blocks of dry ice per day.

▶ **Bazooka Helps Neutralization**—To put phosphoric acid neutralization on a continuous basis Westvaco engineers had



FOUR-STAGE, 700-hp. compressor illustrates Westvaco's philosophy of using large, single units.

to find how to inhibit the obstructive foam formed by the reaction. Two methods were developed—physical break-up of the foam with special devices and limiting the volume of foam-supporting medium. Both are being used.

Soda ash slurry and acid first meet in a device designed to break up the foam by physical means. Plant operators call this device the "bazooka" because of the vigorous, rapid evolution of CO_2 that occurs.

A relatively small secondary reaction tank suppresses further foam formation by limiting the quantity of foam-supporting phosphate liquor present.

Byproduct CO_2 passes through a cooler, where its temperature drops from 212 F. to 100 F. A significant quantity of water condenses out.

The gas then goes to a 30,000-cu.-ft. dry-seal gas holder.

The phosphate liquor, a mixed solution of monosodium and disodium phosphate, passes along for the manufacture of various phosphate products.

▶**Making the Dry Ice**—Since the carbon dioxide gas produced is of high concentration many of the ordinary processing steps (e.g., absorption and stripping) are eliminated at Westvaco. Although the remaining operations follow conventional practice, the plant is compact and efficient.

After the first stage of compression the CO_2 goes to a permanganate column, which scrubs the gas free of odor-imparting constituents. After a second stage of compression any lubricating oil in the gas is removed by a special filter, and the gas stream then passes through an alumina-gel drying system.

A series of cooling operations (through condensers) and expansions (in flash tanks) drop the temperature and liquefy the purified, dry CO_2. The final "flash" occurs in the presses, where the dry ice "snow" forms as the liquid carbon dioxide passes through its triple point.

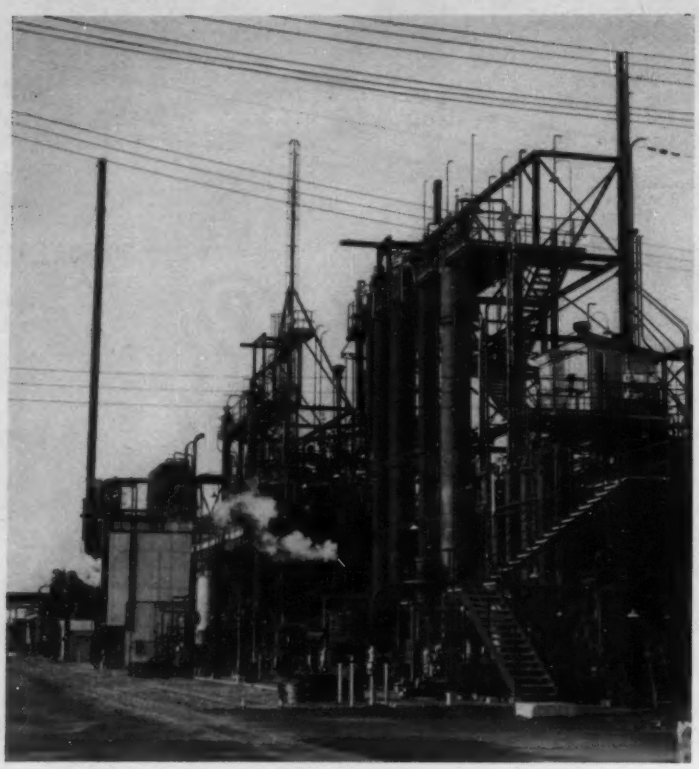
▶**Supplying the Market**—The snow is pressed, sawed into 10x10x10-in. blocks and shipped to a 300-mile-radius market. Westvaco does not have facilities for handling a liquid carbon dioxide product.

With proper scheduling, routine maintenance of the large units of the plant can be done during the winter months when the demand for dry ice is at its lowest. With the big summer demand coming up soon, Westvaco is getting primed for capacity operation.

High-Pressure Acetylene Products Plant Starts Up

Manufacture of high-pressure acetylene products on full commercial scale for the first time in the U. S. is now under way in General Aniline & Film Corp.'s new plant at Calvert City, Ky.

Among the products from this plant will be polyvinyl pyrrolidone (PVP), propargyl alcohol, butyrolactone and butanediol.



With Du Pont's new Deepwater plant a little in the lead . . .

Three Entries Swell Isocyanates Field

New Du Pont, Mobay, National Aniline plants get large-scale production of isocyanates off to a thundering start.

Recent moves by Du Pont, Mobay and Allied Chemical's National Aniline Div. have yanked isocyanates straight out of the pilot-plant stage into the big time. Du Pont put a $10-million, 25-million lb./yr. tolyl diisocyanate plant on stream during February at its Deepwater Point, N. J., Chambers Works. That month, Mobay started up a 10- to 17-million-lb./yr. unit at New Martinsville, W. Va., though all parts of the plant were not yet completed. And National Aniline reported plans to open a 6- to 8-million-lb./yr. plant in Moundsville, W. Va., around midyear.

Mobay has already announced plans to triple its facilities.

Key intermediates in making a wide variety of polyurethanes (*Chem. Eng.*, Sept. 1955, p. 112), organic isocyanates (Du Pont's trade name is Hylene) produce a foam upon reaction with a resin like polyethylene glycol in the presence of water and a catalyst.

Only about 1 million lb. of isocyanates was sold last year. But market growth, fast enough to absorb the big production jump, is expected with increase in urethane use in many applications formerly marked for foam rubber. Among these: Pillows, cushions, rug underlays, automobile crashpads, toys, shoulder pads in clothes. The new material is said to excel in strength, lightness, resistance to oil, dirt and dry-cleaning solvents. About 50 U. S. companies are now manufacturing these polyurethane foams, according to an estimate by Du Pont (which itself has no intention of entering the foam business).

Besides the new big plungers, other companies manufacturing the isocyanates in smaller quantities include B. F. Goodrich at Shelton, Conn., Carwin Co. at North Haven, Conn., and Westvaco's Chlor-Alkali Div. at Charleston, W. Va.

Convention Calendar

American Institute of Chemical Engineers, national meeting, including symposia on "Foreign Developments and Their Effect on the U. S. Chemical Industry" and "Liquid Metals," Roosevelt Hotel, New Orleans, La., May 6-9.

Chemical Market Research Assn., "The Chemical Industry: Review and Forecast," Biltmore Hotel, New York, May 14-15.

American Petroleum Institute, Division of Refining's mid-year meeting, Sheraton Mount Royal Hotel, Montreal, May 14-17.

Armour Research Foundation, Industrial Nuclear Technology Conference, Museum of Science and Industry, Chicago, May 15-16.

Purdue Industrial Waste Conference, Purdue Memorial Union, Lafayette, Ind., May 15-17.

Chemical Institute of Canada, 39th annual conference, Sheraton Mount Royal Hotel, Montreal, May 28-30.

Forest Products Research Society, 10th national meeting, Asheville, N. C., June 4-7.

American Society for Quality Control, 10th annual convention, Palais du Commerce, Montreal, June 6-8.

Society of the Plastics Industry, Seventh National Plastics Exposition, Coliseum, New York, June 11-15.

GENERAL CHEMICAL ANNOUNCES ANOTHER NEW PLANT TO PRODUCE SULFAN®* FOR FASTER, BETTER SULFONATIONS, SULFATIONS

NEW YORK, N. Y.—A large, new plant for the production of "Sulfan" Stabilized Sulfuric Anhydride is now being built at Chicago, Ill., by General Chemical, making additional tonnages of this versatile sulfonating agent available to industry.

The new plant will augment production at General's present Buffalo, N. Y., plant, where production has been expanded repeatedly during the past six years to meet the ever-growing demand for this easy-to-handle liquid form of SO_3.

"The Calumet plant has become a necessity as more and more industries discover the advantages of 'Sulfan' as a faster, better means of conducting sulfonations and sulfations," the announcement stated.

Here's How Sulfan Can Benefit You!

Users in many fields have found that "Sulfan" lets them produce finer sulfonated products at lower costs. One notable example is provided by producers of "low-salt" liquid detergents who find that it eliminates their salt removal problem entirely. And there are many others in a score of industries who are turning to "Sulfan" because it—

1. Furnishes more than 99% available SO_3 in easy-to-handle liquid form.
2. Offers 9 times as much usable SO_3 as 100% Sulfuric Acid, and more than 3 times as much as 20% Oleum for many operations.
3. Is 100% active—every pound that goes into process can be utilized for sulfonating.
4. Frequently eliminates spent acid and its disposal problems.
5. Permits increased batch sizes or more rapid through-put—often as much as double—without increasing size of equipment.

Still other advantages and economies may be offered by "Sulfan" in your own operations. If you sulfonate or sulfate, it will pay you to get all the facts about "Sulfan" now. Phone or write . . .

Basic Chemicals for American Industry

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*Stabilized Sulfuric Anhydride

SIX CELLS in series, supplied with 25-v. selenium-rectified d.c., make 70 lb./hr. of chlorine.

Do It Yourself in Small Mercury Cells

New "packaged" low-amperage cell is tailored for the small chlorine-caustic user. Unique cathode design is outstanding engineering feature.

A new mercury cell, designed for the small chlorine-caustic user, invites "do-it-yourself" operation. First to accept: Power Station of Pretoria, South Africa, whose installation is shown above. This one-time chlorine buyer is now a chlorine and caustic soda manufacturer.

Six of the new cells—developed by International Electrolytic Plant Co., Sandycroft, Chester, England—comprise the guts of the compact Pretoria plant. Output is 70 lb./hr. of chlorine, plus its equivalent NaOH. The Power Station uses the chlorine to arrest damaging cooling-water algae growth, sells the caustic soda.

▶**Fills the Bill**—International supplied most of the necessary accessory equipment as well as the cells—rectifiers, brine purification system, chlorine injectors, caustic liquor storage tanks. A water-cooled selenium rectifier supplies direct current. Located in a separate room, the rectifier can be controlled remotely from the cell room when modification of loading is desired.

Complete installation at Pretoria cost only $42,000. This would indicate that IEP has whipped that long-standing deterrent to small mercury cell operations—high initial cost.

And its other appealing features commended it solidly to Pretoria's specific needs. Pretoria had:

• No access to skilled chemical operators; International's cell is simple to operate, boasts long life with minimum maintenance.

• Market for high-quality caustic soda; International's cell produces 50% rayon-grade caustic directly, sale of which cuts down net cost of chlorine.

▶**Tailored to Size**—Designed as it is for modest production demands, the IEP cell has two features which distinguish it from mercury cells used by large producers: The denuding compartment is slung beneath the electrolyzer, double-berth fashion, saving valuable floor space and making a small package that can be squeezed into a spare corner; operating current is only 3,000-4,000 amp., permitting series hookup to boost over-all voltage drop into the range of conventional selenium rectifiers.

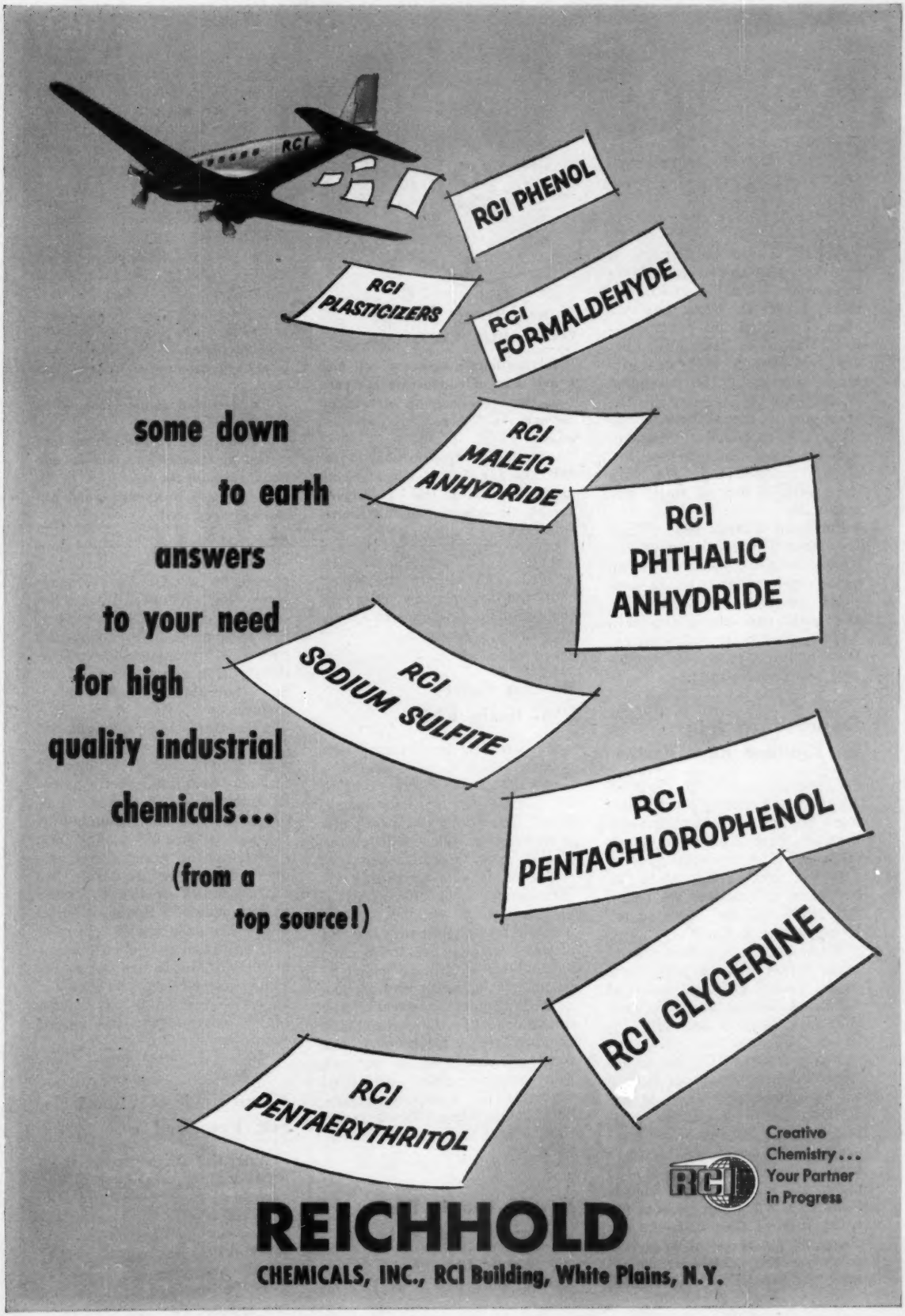
Another bright development by International is the unique cathode bar arrangement (*see sketch*, p. 120). Primary value: It beats the corrosion problem that harasses other designs.

▶**Electrolyzer Design**—This is a rubber-lined steel trough, 12 ft. long, 18 in. wide and 3 in. deep. The 20 graphite anodes are each 16x7x2 in. Mercury, as the cathode, makes electrical contact through the novel steel-clad copper tube arrangement. Brine is preheated electrically to 40 C.

The De Nora mercury cell, widely used for large-scale production, uses a stone lining (of styenite); the Mathieson cell, however, on the other hand, is lined with hard rubber, like the IEP unit.

▶**Decomposer Design**—Denuding compartment is a 6½-in.-dia. steel cylinder. Mercury and sodium amalgam drain by gravity from the electrolyzer above.

Semicircular graphite blocks, fitted into the bottom of the denuder, serve as the cathode, the amalgam as the anode, in the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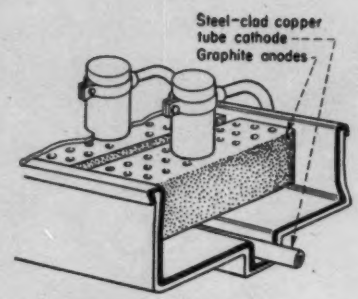
ensuing decomposition reaction with water. The reaction produces caustic soda and hydrogen and regenerates the mercury for recycle.

Mercury returns to the electrolyzer via a pump. Losses of mercury are kept low—from 0.50 to 0.75 lb./ton chlorine produced.

De Nora and Mathieson, in contrast, use tower-shaped denuders located at the end of the electrolyzer. De Nora uses two stages of amalgam decomposition, Mathieson, one. Both towers are packed with graphite slugs flooded by the amalgam. Water flow is counter to the amalgam in the Mathieson design, also in the first stage of the De Nora decomposer. But in the second stage De Nora uses parallel flow of water and amalgam.

▶**Potential Users**—IEP visualizes adoption of the new cell by textile mills, bleach solution producers, water-treating stations, etc. Such users need only the basic raw materials—salt, water, electricity—to convert from buyer to producer of chlorine and caustic soda.



New Cathode Design Overcomes Corrosion

International's mercury cell has a new way of conducting the current from the moving stream of mercury to the negative cell terminal.

A steel-clad copper tube, 1⅛ in. O.D. and ¾ in. I.D., lies in a groove at the bottom of the electrolyzer trough. It extends the full length of the cell, with its ends projecting beyond the electrolyzer. The negative copper conductors bolt onto the ends. Mercury always fills the groove, keeping the tube submerged, even when the cell is shut down.

Here's what this design means:

- **Complete hard-rubber lining of the cell is possible.**
- **There are no metal-to-rubber joints; mercury or chlorinated brine cannot penetrate to and corrode the steelwork of the cell.**
- **Plant shutdowns do not provoke corrosion, since cathode tube is always submerged in the mercury.**
- **Steel-clad copper tube is an excellent conductor.**
- **Cell temperature can be controlled by circulating a hot or cold liquid through the tube.**
- **Tube is inexpensive and can be easily replaced.**

Crane, Vitro Join To Produce Rare Earths

Crane Co. and Vitro Corp. of America will shortly start building a $6-million plant to produce thorium, rare earths and heavy minerals from monazite, rutile, ilmenite, zircon and kyanite. To be located in Chattanooga, Tenn., the plant will be operated by Heavy Minerals Co.

Vitro and Crane have acquired equal ownership. A subsidiary of the French chemical group of Pechiney, known as STR, continues to hold a minority interest.

Heavy Minerals Co. has an exclusive North American license to numerous patents held by STR on the processing of thorium, rare earths and heavy minerals. On the negative side, it has been definitely stated that the plant will not use Light Metals Refining Corp.'s new process for using intense arcs to carry out chemical reactions at temperatures in the 15,000-20,000 F. range (*Chem. Eng.*, Apr. 1956, p. 108). This, despite the report that the arc process is going through final development stages at Vitro's laboratories.

Borden Enters PVC Resin Field

Borden Co. is entering the polyvinyl chloride resin field with a new 12-million-lb./yr. plant to be completed in Leominster, Mass., this June. The new plant is adjacent to existing polyvinyl alcohol and acetate units.

Borden is also expanding its formaldehyde capacity: With a $1 - million, 36 - million - lb./yr. plant to be completed by the end of this year near Seattle, Wash.; by doubling existing capacity of its plant at Cubatao, Brazil. The Brazilian plant is part of the company's $3.5-million expansion program there, which also calls for the building of the nation's first methanol plant and added facilities for synthetic resins, both at Cubatao. All construction is set for completion by 1958.

New Ammonia Plant Opened by Sun Oil

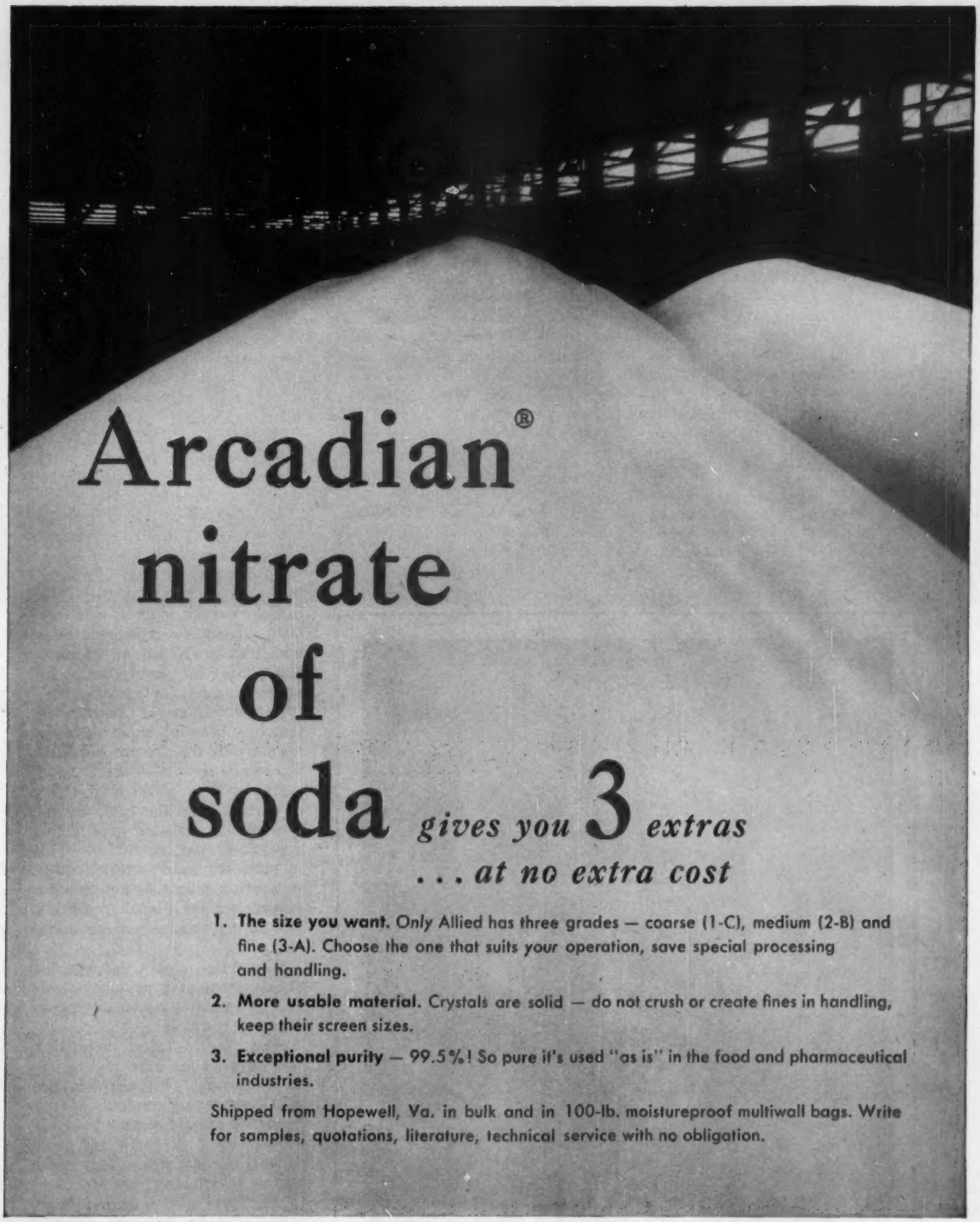
A $10-million anhydrous ammonia plant has been put on stream at Sun Oil Co.'s Marcus Hook (Pa.) refinery. With a design capacity of 300 tons/day, the plant operates on byproduct hydrogen from petroleum operations. Hydrogen comes from Sun's two Marcus Hook Houdriformers.

An interesting sidelight on Sun: The company has started a novel marketing experiment by tailoring gasoline and its prices to automobiles of various compression ratios at a number of service stations in Orlando, Fla. —blending at pump "five progressively higher grades with a top antiknock quality in excess of 100 octane." Double-pronged aim of the experiment is to meet fuel requirements of automobile engines of the future but at the same time to relieve the owner of an older car from paying for higher octane than his engine requires.

More Mexican Chemicals Set, Proposed

With the single exception of a $16-million home-government-sponsored fertilizer plant, a diversified round of new chemical plants has been set or proposed for Mexico by foreign investors, mostly American.

To be operated by Guanos y



Arcadian® nitrate of soda *gives you* 3 *extras . . . at no extra cost*

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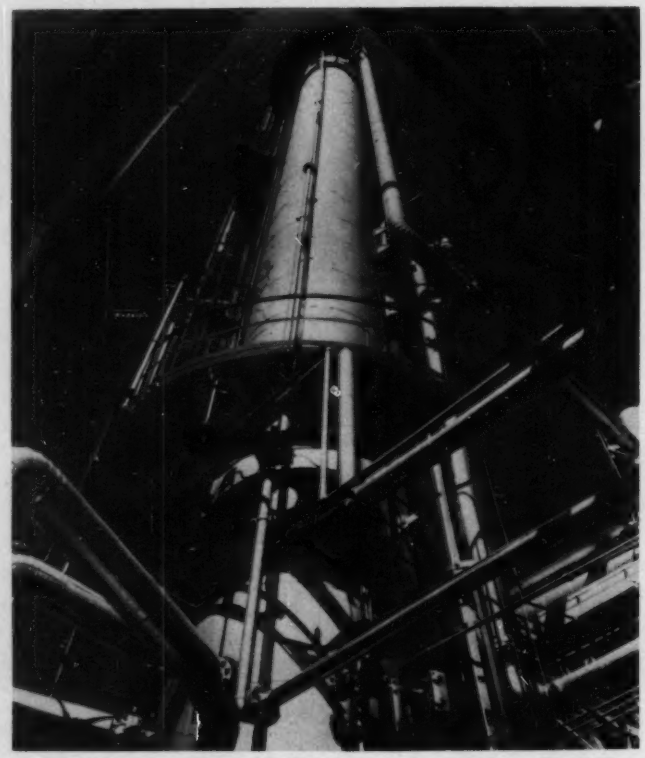
Fertilizantes, S.A., a government unit, the fertilizer plant will probably be built on the Isthmus of Tehuantepec to produce daily 120-150 tons of ammonia, 250 tons of ammonium nitrate and 140-300 tons of triple superphosphate. To be completed in about two years, the plant would use phosphate rock imported from the U. S.; sulfur and natural gas would come from nearby natural sources.

Celanese Mexicana, affiliate of Celanese Corp. of America, has just announced a $5.6-million program of expansion and diversification to be completed by year's end. A 440,000-lb./yr. polyester plant will be built in Mexico City. Tire cord production at the firm's plant at Toluca, near Mexico City, will be expanded from 2.2 million to 6.6 million lb./yr. Anhydrous sodium sulfate production will be started at a branch plant in Zacapu, Morelos.

Pan American Sulphur Co. is about to undertake a $1.5-million expansion of its sulfur plant in Vera Cruz. To be completed this fall, it will increase daily producing capacity from 2,000 tons to over 3,000.

Monsanto Mexicana, S.A., largest Latin-American subsidiary of Monsanto Chemical, recently began production of salicylic acid in Lecheria, near Mexico City.

And several West European chemical firms are studying the possibilities of producing caustic soda in Mexico to supply the constantly increasing demand. Additional production to meet these needs would entail investment of about $8 million. What is particularly attracting attention of foreign chemical firms is the practically inexhaustible supply of raw materials for caustic manufacture in the bed of the old Texcoco Lake near Mexico City.



STABILIZATION TOWER at the Provence, France, refinery of Compagnie Francaise de Raffinage has a capacity of 3,500 tons/day. A new distillation unit was recently put on stream at the plant with a 10,000-ton/day capacity.

Industry to Set Own Atom Standards

National standards for commercial and industrial use of fissionable materials are now being forged by 17 industries making use of atomic energy, together with public safety and government agencies.

Including AIChE representation, the group plans to work, according to procedures of the American Standards Assn., on: General or administrative standards, such as those for terminology, symbols and color codes; radiation protection of people and property; standards for nuclear safety, such as site location, laboratory experimentation and transportation or storage; standards for equipment, for processes and for materials.

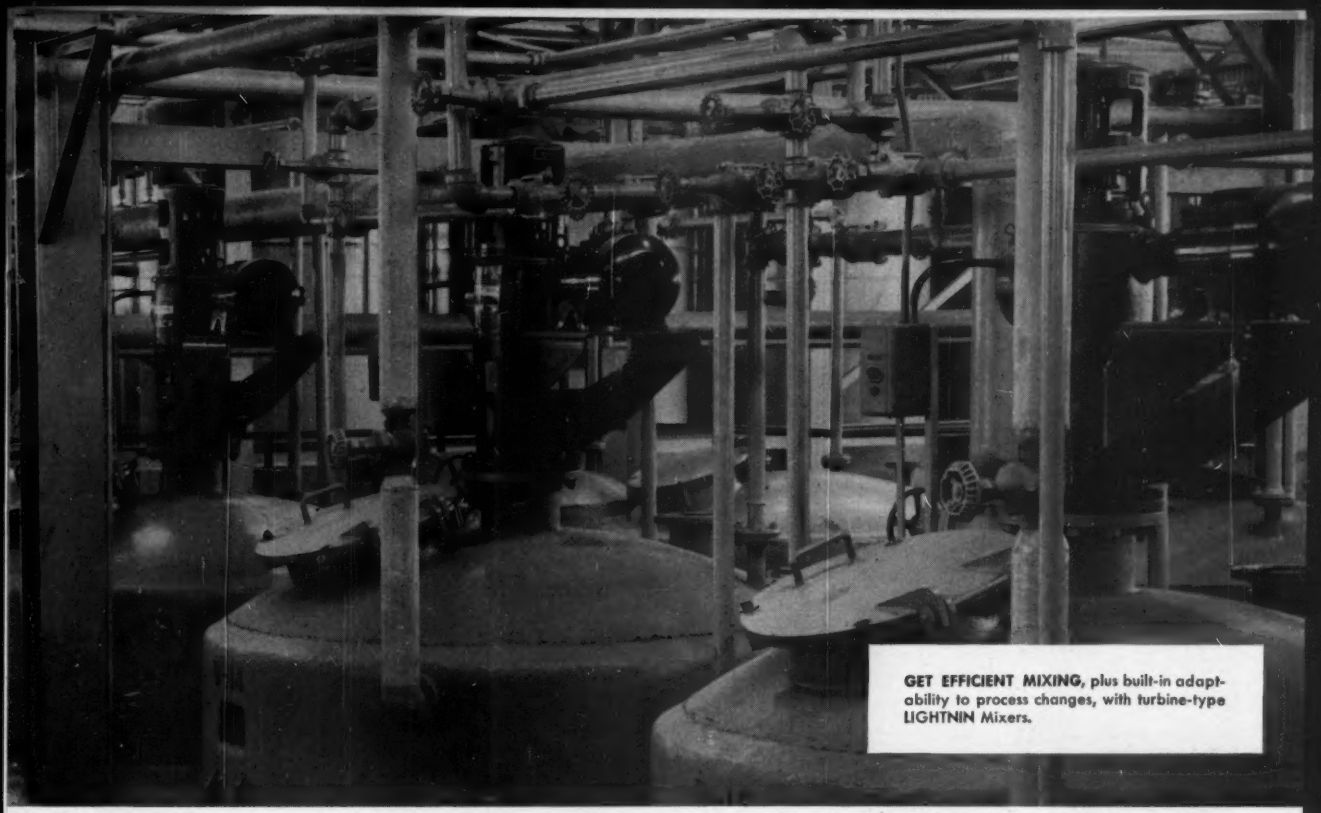
Atomic Energy Commission, too, has been at work on some regulations for private industry. These are now in effect.

One of them governs licensing of virtually all domestic atomic energy installations except fuel manufacturing facilities. This includes nuclear reactors, isotope separation plants and plants for processing irradiated materials containing special nuclear material.

The action clears the way for development of a private atomic energy industry under close government control.

And for foreign activities, there's another new regulation. It authorizes, without advance AEC approval, conduct of unclassified atomic energy business abroad by U. S. firms and individuals in countries not members of the Soviet bloc.

AEC has also authorized design and development of two high-energy particle accelerators: One by the Midwest Universities Assn.; the other by Argonne National Laboratory, to be completed as soon as possible as a basis for studies of the theory and design of advanced high-energy accelerators.



GET EFFICIENT MIXING, plus built-in adaptability to process changes, with turbine-type LIGHTNIN Mixers.

Use this **proved method** *to get good fluid mixing*

You can't afford to *guess* about fluid mixing. And you don't need to.

On any mixing operation you can get factual answers to questions like these, to guide you in your mixer selection:

1. What precise balance of *fluid flow* and *fluid shear* will do my mixing job best?
2. If this balance can be attained in different ways, what is the *most efficient* and economical way?
3. In scaling-up, does power required per unit volume remain constant? If not, by what factor does it increase or decrease?
4. Will the mixer transmit the required power to the mix, and do it efficiently?
5. Can the mixer be installed without special construction? Can I get standard replacement parts quickly if I ever need them?
6. Am I protected against mixer obsolescence in case of a process change?

You *know* the answers to these vital questions, when you mix with LIGHTNIN Mixers.

Predicting results

Even on the simplest mixer application, your LIGHTNIN sales engineer's recommendation is based on thousands of pilot runs, plus years of in-the-field experience.

On complex mixing jobs, pilot runs at MIXCO quickly find the impeller-to-tank diameter ratio and input power that will produce the optimum fluid regime most economically. Scale-up is *guaranteed accurate.*

Mechanical economy

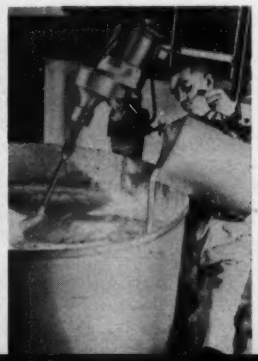
Your mixer investment goes into equipment that is mechanically up-to-the-minute. Hundreds of *standard* LIGHTNIN power-speed combinations (interchangeable in many models); widest possible choice of in-stock materials and interchangeable components, give you assurance of correct application, smooth running, and flexibility when you need it.

For fluid mixing that does what you want it to do, call in your LIGHTNIN Mixer representative. (He's listed in Chemical Engineering Catalog.) Or write us direct.

Left: **ANY TANK,** regardless of size or shape, can be fitted with a LIGHTNIN Mixer for correct mixing. ***Right:*** Make any open tank an effective mixing unit, with a LIGHTNIN Portable Mixer. Thirty models.

"Lightnin® Mixers"

MIXCO fluid mixing specialists



FOR LATEST MIXING INFORMATION and full description of LIGHTNIN Mixers, send for these helpful bulletins:

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- ☐ B-103 Top entering; propeller types: ¼ to 3 HP
- ☐ B-108 Portable: ⅛ to 3 HP
- ☐ B-104 Side entering: 1 to 25 HP
- ☐ B-112 Laboratory and small-batch production types
- ☐ B-109 Condensed catalog showing all types
- ☐ B-111 Quick-change rotary mechanical seals for pressure and vacuum mixing
- ☐ B-107 Data sheet for figuring mixer requirements

Check, clip, and mail with your name, title, company address to:

MIXING EQUIPMENT Co., Inc., 128-e Mt. Read Blvd., Rochester 11, N. Y.

In Canada: Greey Mixing Equipment, Ltd., Toronto 10, Ont.

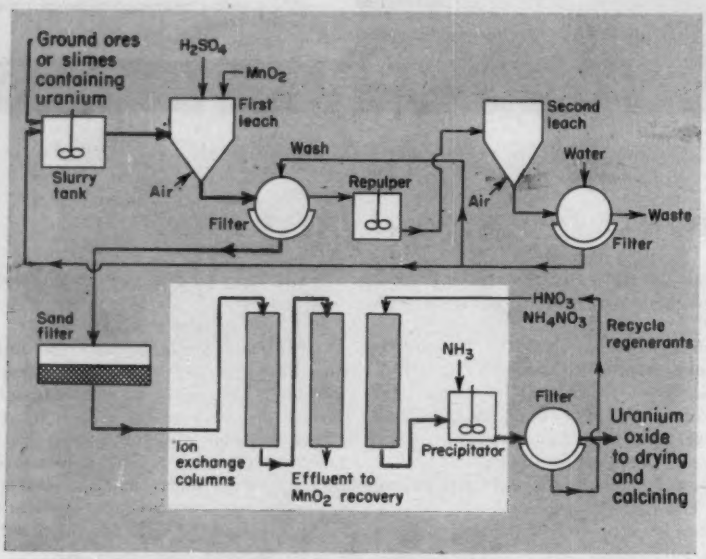
More Uranium Secrets Can Now Be Told

- **How ion exchange has hit the big time in processing of uranium ores.**
- **How one uranium-from-gold-slimes plant conquers corrosive conditions.**
- **How solvent extraction recovers uranium from Florida phosphate rock.**

For several years most of you have been aware of the growing use of such chemical engineering unit operations as solvent extraction and ion exchange in the production of natural uranium. However, details about these operations have been classified.

Lowering of security bars in recent months has brought to light specific information about what is going on in Atomic Energy Commission's raw materials program. There's a lot of good chemical engineering involved.

We think that you'll be interested in the uranium processing developments reported here.



FLOWSHEET above is typical of most uranium-via-ion-exchange plants.

Ion Exchange Strikes It Rich

Recovery of uranium from ores or waste slimes is now biggest use outside of water-treatment field.

For years the makers of ion exchangers have been patiently and persistently probing into all types of chemical processing operations in an effort to find a big market for their wares outside the water-treatment field. According to information declassified in recent months, they've hit their big strike.

More than 20 large installations throughout the world are now using ion exchange to process uranium ores. And many additional plants are being designed.

Largest installation to date uses 45 ion-exchange columns. It's believed that few, if any, water plants can top this.

▶ **Joint Effort**—Like most developments in the uranium program, many different individuals and groups helped put ion exchange into the flowsheet.

Early laboratory work was done by Battelle Memorial Institute and Massachusetts Institute of Technology. This work was at first disappointingly unsuccessful. Big breakthrough came when Battelle found that uranium complexes could be extracted selectively from sulfuric acid solutions with anion-exchange resins, rather than extracting uranium ions with cation-exchange resins.

Dow Chemical and Rohm & Haas get credit for much of the pilot-plant process development, done under AEC contracts. And Permutit Co. claims credit for independent work, particularly on the chemistry of the process.

▶ **Adsorbed on Strong-Base Resins**—Here's how ion exchange fits into the over-all picture:

After leaching ground ore or waste slimes with dilute sulfuric acid in the presence of manganese dioxide, pulp is filtered (or clarified by countercurrent decantation). Clear solution then passes through ion exchange beds made up of strong-base quarternary ammonium ion-exchange resins.

Here uranium sulfate complex ions are adsorbed, along with other anions which may be present, e.g., vanadium, molybdenum, ferric sulfate anionic complex, chlorate, cobalticyanide and polythionate anions. Some of these anions are removed with uranium in subsequent elution.

But some anions like molybdenum, cobalticyanide and polythionate aren't completely removed by elution. They slowly accumulate in the beds, causing large capacity losses and reduced reaction rates of the resin. Caustic solution treat-

J-M 85% Magnesia is lightweight . . . easy for workmen to install half-sections on this 10" steam line. Insulation work at the Grace Chemical plant was performed by Young Sales Corporation of St. Louis. Engineering and construction was directed by Foster Wheeler Corporation of New York.

Your Btu's and dollars go further when you specify **Johns-Manville 85% Magnesia**

. . . the choice of insulation engineers at Grace Chemical's new Memphis plant

INDUSTRY'S LONG-TIME standard for temperatures to 600F is still your best insulation buy. For J-M 85% Magnesia provides high insulating value, easy application, long life, initial low cost and minimum maintenance. That's why insulation engineers consistently specify J-M 85% Magnesia for modern installations like Grace Chemical's new anhydrous ammonia-urea plant. That's why it will pay you to specify J-M 85% Magnesia for your new plant or modernization program.

To assure you maximum value from your insulation dollar, Johns-Manville gives you complete drawing-board-to-job-site service. You get expert recommendations by the world's most experienced insulation engineers . . . plus expert installation by authorized J-M Insulation Contractors. Write today for further information on J-M 85% Magnesia and Johns-Manville's unmatched facilities to solve your insulation problems. Address Johns-Manville Box 60, New York 16, N.Y. In Canada, Port Credit, Ontario.

J-M 85% Magnesia also comes in block form. Here you see it being applied to a vertical drum at a New Jersey petroleum refinery.

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ment is often effective in removing these poisons.

▶ **Nitrate or Chloride Elution**—After resin loading, elution is accomplished by passing a solution of either ammonium nitrate and nitric acid or sodium chloride and sulfuric acid through the bed.

Uranium is precipitated quantitatively by neutralizing with ammonia or magnesium oxide to yield the diuranate. Eluant filtrate is made up to its original composition and recycled to the column.

▶ **Automatic Operation** — Most ion-exchange equipment used in uranium recovery is designed for automatic operation. Columns are usually 7-8 ft. dia. and 12 or more ft. high.

Pregnant leach solution flows through two or more beds in series while the other beds are being regenerated. Uranium is sorbed by the resin and, when detected in the final effluent, freshly regenerated beds are switched in downstream to act as "cleanup" beds.

▶ **Modification Saves a Step**—Although ion exchange has been in operation commercially for two to three years, most of Dow's recent development work has been on a modified process, resin-in-pulp (RIP).

In this process large-mesh resins contained in stainless steel baskets are immersed directly into the leached pulp, thus eliminating the filtration stage. Slurry is contacted successively with several of these baskets to load up the resin, which is then eluted.

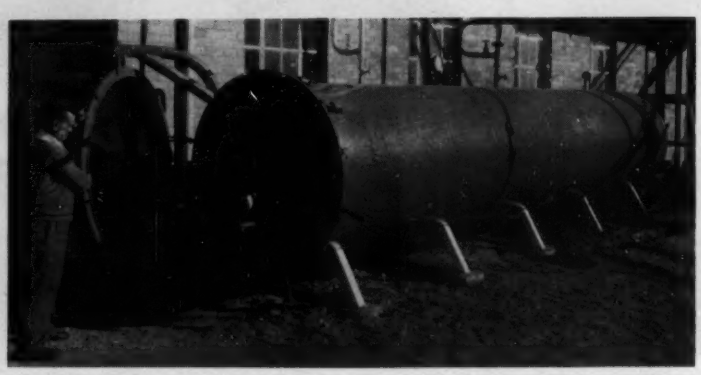
Although RIP has the definite advantage of eliminating what is often an expensive filtration step (presence of slimes slows up acid pulp filtration), Dow admits that the process has two major drawbacks:

- Large resin (+20 mesh) hikes chemicals costs and resin inventories.
- Investment and maintenance costs are high.

Whether or not the pro's outweigh the con's has not yet been established, inasmuch as RIP is still quite new. But the question should be resolved soon after the two plants already in operation and the five or more being built gain more operating experience.

RUBBER lining is drawn into pipe.

AIR pressure blows up lining.



VULCANIZING of rubber-lined pipe and fittings is done in this autoclave.

Acid-Leaching Demands Careful Design

Protection against corrosive conditions has paid off in pioneer uranium-from-gold-slimes plant.

Foresight is more difficult than hindsight — especially when you have the job of pioneering a new development in process technology in a country where chemical processing is still in its infancy. Here's a case where foresight paid off.

After three years' successful operation of South Africa's first uranium-producing plant at West Rand Consolidated Mines (outside of Johannesburg), no fundamental changes have been found necessary in engineering design. Problems involved in acid extraction of uranium from waste gold slimes—corrosion, abrasion by acid pulp, receiving, handling and storing of reagents—have been met and solved.

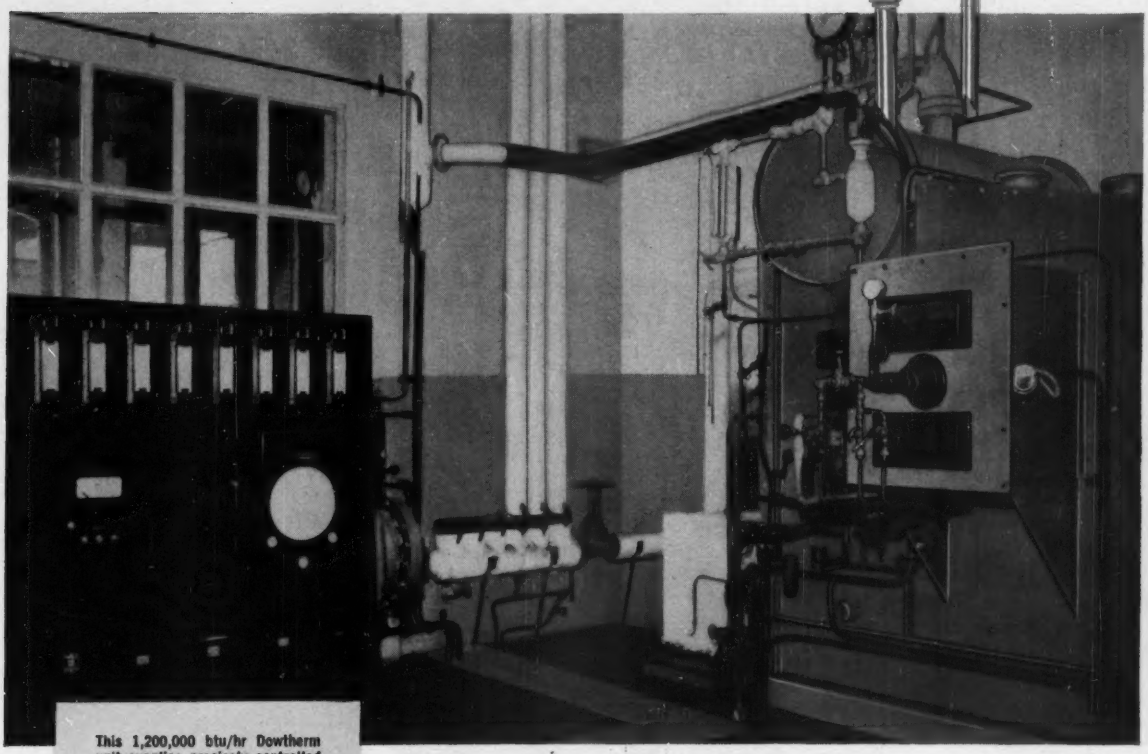
▶ **Vital Extra Step**—Extraction of uranium from waste gold slimes (i.e., slimes from treated gold-bearing ores) is similar to many hydrometallurgical processes involving leaching, filtration and precipitation. The one essential difference is that uranium recovery requires an extra step between filtration and precipitation—purification of the filtrate via ion exchange.

Filter cake from the gold plant is repulped and air-agi-

HERE'S WHY YOU ARE AHEAD WITH FOSTER WHEELER

HIGH-TEMPERATURE LOW-PRESSURE

PROCESS HEATING SYSTEMS



This 1,200,000 btu/hr Dowtherm unit supplies precisely controlled process heating at 650F, 53 psi, for a fatty acid distillation plant at Compania BAO, Montevideo, Uruguay. Designed and engineered by Foster Wheeler, this plant has a rated capacity of 1500 lb per hr of crude fatty acid.

FW does the Complete Job

DESIGN
INSTALLATION
OPERATION
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FW Dowtherm heating systems provide a vapor temperature range of 500F to 700F at vapor pressures of 15 psi to 95 psi absolute, fraction-of-a-degree temperature control, uniform temperatures throughout each processing step, fully automatic operation and low maintenance and repair costs.

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tated with dilute H_2SO_4 in conical-bottom tanks. Manganese dioxide is used in the leaching stage as an oxidizing agent.

Two-stage filtration of pulp, on rotary drum filters, yields a uranium-rich filtrate and a solid residue which is discharged to slime dams. Since filtration of acid pulp is difficult, a coagulant, animal glue, is added.

Impure uranium-rich filtrate undergoes purification via passage through 12 ion-exchange columns. And uranium is precipitated by addition of ammonia to the pure solution. Filtration, drying and calcining complete the operation.

▶ **Acid-Proof Brick for Concrete** —One of the two major problems facing design engineers was the protection of concrete construction — foundations, sumps, drainage channels, floors—from acid attack. Though protection isn't limited to any one technique, the one chosen involves the use of acid-proof brick lining set in acid-proof cements with an impervious membrane between brick lining and concrete.

Choice of brick lining, as compared with straight mastic, is dictated by certain advantages: Protection from mechanical damage, oils, greases and solvents, high temperatures.

This is how brickwork is laid: Two coats of good-quality bituminous primer are applied to homogeneous, thoroughly dry and water-tight concrete. This is followed by a single coating with an acid-resisting membrane (hot mixture of high-grade bitumen with fillers). On top of the membrane, acid-proof bricks are bedded on ¼-in. silicate cement with joints fully buttered with silicate cement.

▶ **Protecting Steel Equipment**— The second problem was the protection of steel equipment from corrosion and abrasion. Though many methods were investigated, the final choice was to line tanks, pipework, etc., with ⅛-in.-thick rubber.

First step in rubber lining equipment consists of applying two coats of a rubber chloride solution to thoroughly dry and clean base material. This is followed by coating with two layers of intermediate cement.

The first cement coating is allowed to dry and the compounded rubber sheet, of correct size and shape, is placed on the second coat, while tacky.

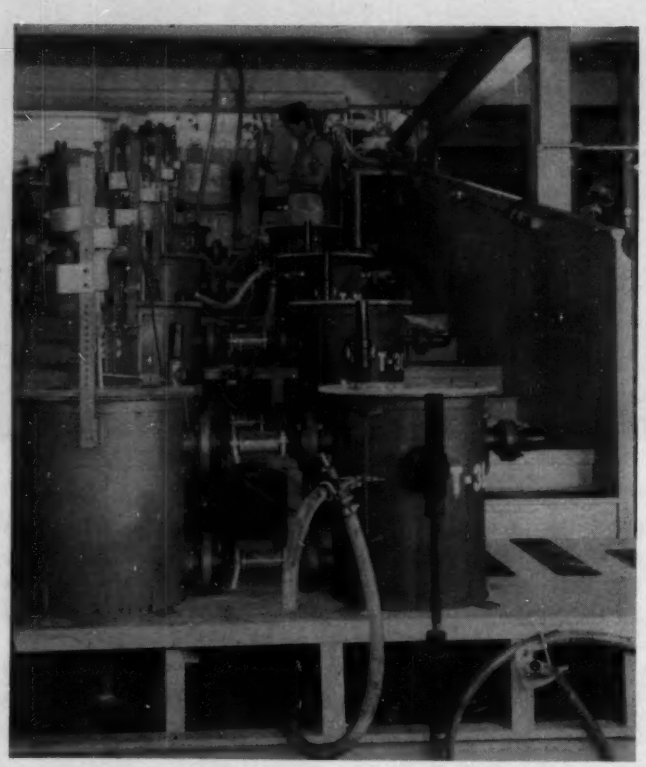
After the sheet is positioned and rolled on, the entire piece is vulcanized by one of three methods: (1) Placing the entire rubber-covered article in an autoclave and admitting steam under pressure; (2) filling the piece of equipment, if it can be closed, with steam or boiling water; (3) chemically curing with carbon bisulfide.

▶ **Rubber-Lined Pipes** — In a similar manner, piping can be rubber lined. But the trick is to make the lining stick to the inside of the pipe.

The way it's done is to apply a first coat of metal adhesive to the cleaned inner surface of the pipe. During application of the adhesive, and while it's drying, the pipe is inclined at an angle so that excess solution will drain off.

When most of the solvent has evaporated and the adhesive is still wet, a first coat of cement is applied. After this has dried thoroughly, a second coat is applied just prior to application of the lining.

The lining is made by cutting a length of rubber stock of suitable diameter, forming a tube on a mandrel, applying cement



Solvent Extraction Challenges Ion Exchange

Work being done in this Bureau of Mines pilot plant at Salt Lake City bids fair to put solvent extraction on a more favorable competitive position vs. ion exchange in the uranium raw materials program. Development of improved solvents will permit uranium processors to capitalize on solvent extraction's inherent advantage of simple, continuous operation.

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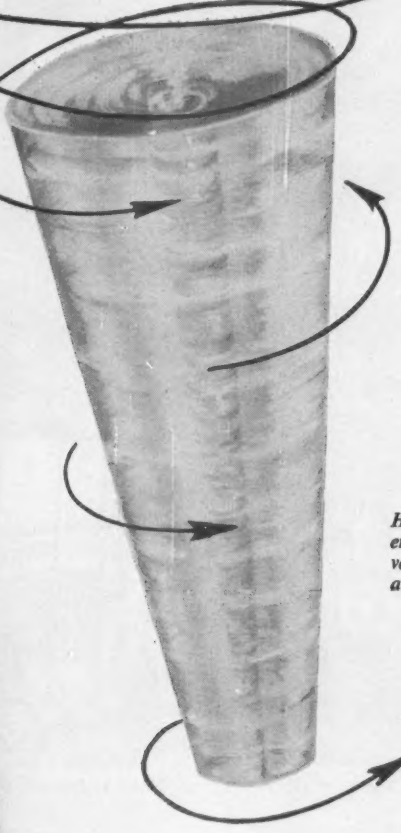

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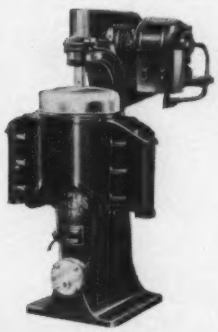

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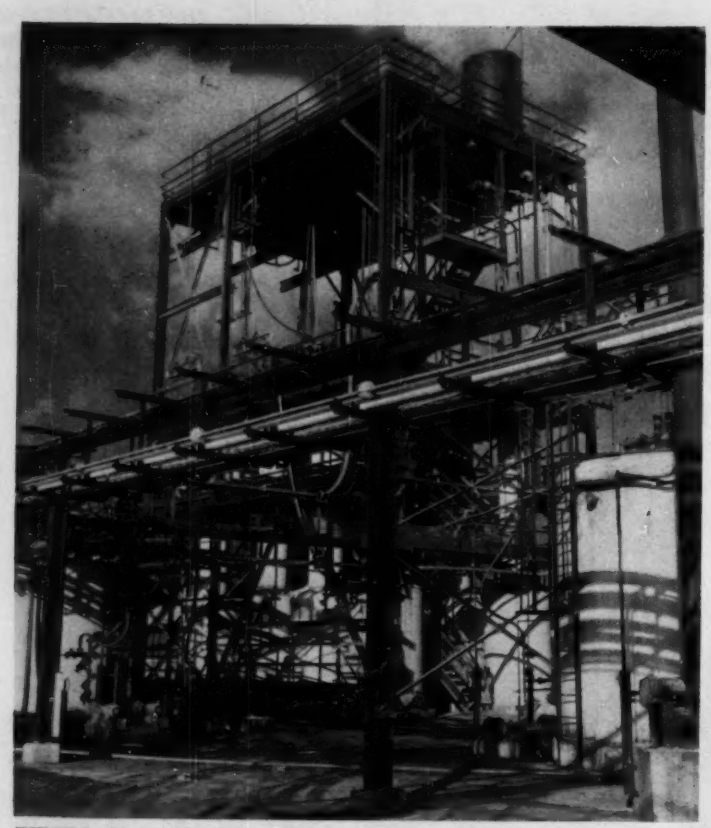
to the outer surface of the tube and drawing it through the pipe.

Sufficient air pressure (60-70 psi.) is applied to make the tube adhere to the pipe. Then the entire piece is vulcanized in an autoclave.

Rubber coverings and linings can be found in most of West Rand's equipment.

The above story is based on a talk by S. Craib, consulting engineer, General Mining & Finance Corp., Johannesburg, to the South African Institution of Mechanical Engineers. We're grateful to the Institution for permission to publish this material and the photographs.



FIRST inside photo released showing IMC's uranium plant at Bonnie, Fla.

Solvent Extraction Problems Overcome

Here's how smart chemical engineering put uranium recovery from phosphate rock on sound basis.

When International Minerals & Chemical Corp. began extracting uranium from phosphate at Bonnie, Fla., two years ago (*Chem. Eng.*, June 1954, pp. 118, 120), little was said publicly about how they did it.

Now that Atomic Energy Commission has ordered declassification of the raw materials field, IMC can tell the story. And it's a good example of how chemical engineering technology has led to recovery of a critical material which otherwise would be lost.*

▶**Extraction, Precipitation**—International removes uranium from wet-process phosphoric acid by solvent extraction, followed by precipitation. This much was in our earlier story.

The solvent, it has now been disclosed, is a decyl ester of pyrophosphoric acid dissolved in kerosene, and the precipitating agent is hydrofluoric acid. Product is uranium tetrafluoride, known in the trade as "green salt."

The earlier story reported that extraction took place in nine agitated, vertical towers, some 3 ft. dia. and 20 ft. high. Because of poor phase separation, these towers are no longer used. Instead, IMC performs the extraction by violently agitating the phosphoric acid and solvent in tanks, followed by separation in centrifuges.

▶**Working Together** — Dow Chemical and Oak Ridge National Laboratory share credit for the basic process. ORNL screened hundreds of solvents; Dow developed the process steps at its Pittsburg (Calif.) laboratories under AEC contract.

Dow's exploratory work led also to workable ion-exchange processes for recovering uranium from dilute solutions (*see p.* 124). Before making its choice of process to use at Bonnie, IMC studied both methods in detail; solvent extraction won out on an economic basis.

International points out that industrial cooperation in this program has been extraordinary. Uranium-minded men from many companies and AEC have freely exchanged helpful data and knowhow.

▶**Process Outline**—In brief, the process consists of these steps:

- Passing the weak phosphoric acid through a bed of iron stampings to reduce the dissolved uranium to +4 valence.
- Contacting the acid with solvent in agitated tanks.
- Final intimate mixing and separation in centrifuges. Aqueous phase returns to main plant to make feed and fertilizer products.
- Treatment of organic phase with sulfuric acid and HF to precipitate UF_4.
- Centrifuging, washing and drying the cake.

*Just how much is still company confidential. But an order-of-magnitude estimate can be made, based on announced plant throughput of phosphoric acid, average uranium content of Florida phosphate rock (0.01—0.02% U_3O_8) and an assumed recovery of 65%. This gives a figure of about 200 lb./day U_3O_8.

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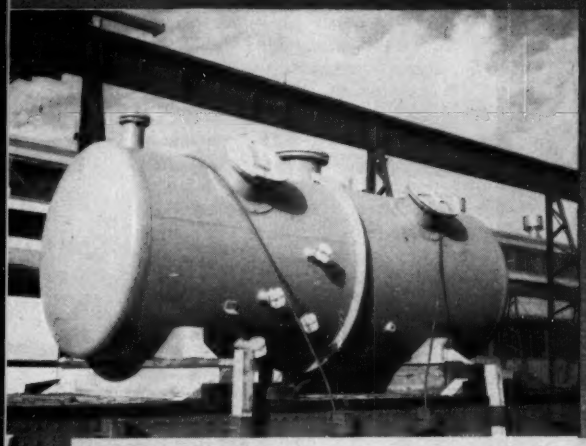
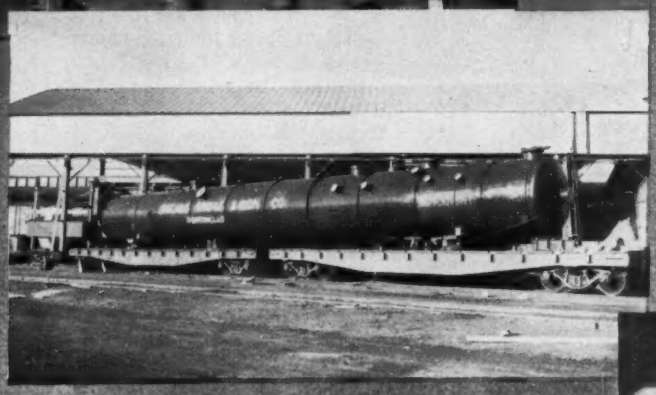
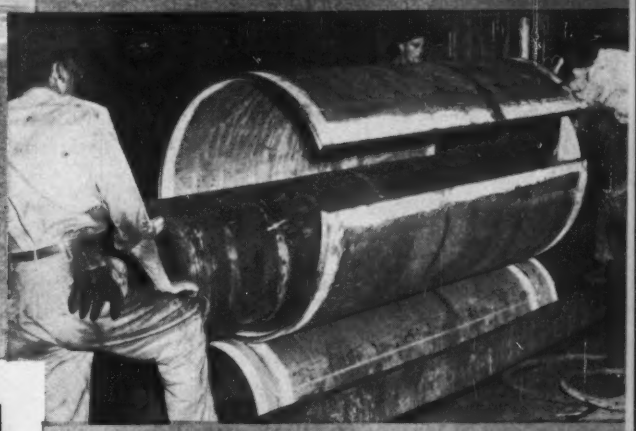




(Top View): Hortonclad condensate drum loaded for shipment.

(Above): Monel Hortonclad and stainless Hortonclad were used in the fabrication of this tower.



(Above): Shell ring of silver Hortonclad on stainless steel being rolled to shape. Combination of fine silver on stainless backing plate could not be produced before the Hortonclad vacuum brazing method of cladding was developed.

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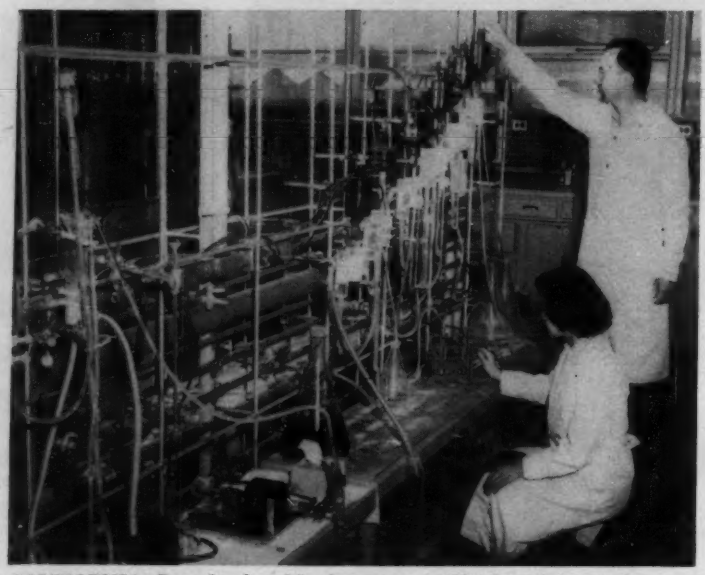
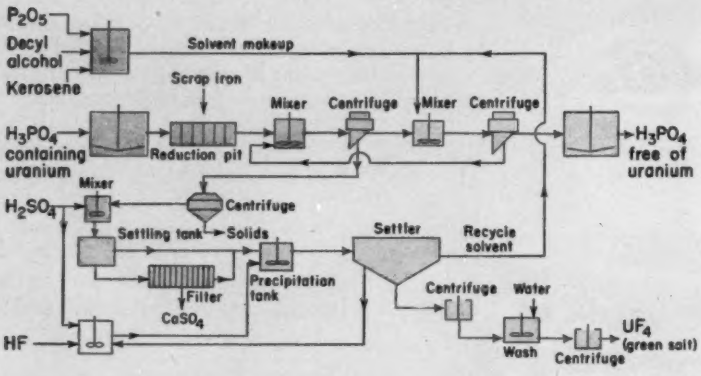
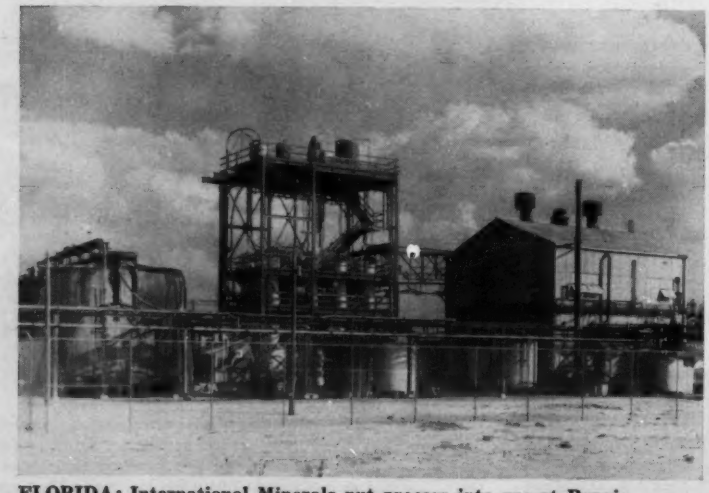


CALIFORNIA: Dow developed basic process in Pittsburg laboratories.





FLORIDA: International Minerals put process into use at Bonnie.

Another operation is preparation of the solvent. Since it's too unstable to bring in from any distance and store in quantity, IMC makes it on the spot by reacting decyl alcohol with phosphoric anhydride slurried in kerosene. Concentration of ester in kerosene is about 5%.

Makeup solvent must be added continually. This is because the ester hydrolyzes to a considerable extent in the presence of both phosphoric acid (during extraction) and HF (during precipitation).

▶**Making It Work** — International's engineers have added refinements to the process as originally worked out by Dow.

One difficulty was with phase separation, as pointed out above. For a while they used a wetting agent. Now they've learned to control the separation step well enough to avoid emulsification.

They also had trouble in reducing the free fluoride concentration in final product. The addition of repulping and washing steps to remove soluble impurities is one of the refinements helping to solve this problem.

Another vexing problem was in preparation of the solvent. At first the batches of solvent varied, even though seemingly prepared in identical manner. This problem was whipped, but IMC won't say just how.

▶**Room for Improvement**—Virginia-Carolina Chemical Corp., which began similar operations at Nichols, Fla., at about the same time as International, is reported to be shut down at the present time. Official comment is that "changes and additions are in progress." Presumably V-C has run into its share of problems, too.

Proceeding at a more conservative pace is U. S. Phosphoric Products. The company is building a large commercial unit at E. Tampa, Fla.

On the other hand, IMC engineers are still trying to improve present operations. And based on the success they've had in overcoming other tough problems in the Bonnie plant's feed and fertilizer production, we're betting on them to come up with cheaper uranium from Florida phosphate.

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Three Chlorine Plants Slated For Southwest

Dow, Wyandotte and Frontier Chemical have all started laying groundwork for big, new Southwestern chlorine-caustic soda facilities.

Dow expects to build a $20-million plant in the Baton Rouge area of Louisiana to produce chlorine, caustic soda and several organic chemicals. Attracted by the availability of water transportation, Dow has taken options on three Mississippi River sites—at Plaquemine, Port Allen and Indian Village. The company has been making extensive use of barge shipment to and from its Texas plant at Freeport via the Intercoastal Waterway and Mississippi River network.

Wyandotte has acquired an option on 700 acres near Baton Rouge, La., where it plans to build a plant to make chlorine and caustic soda, ethylene oxide and ethylene glycol.

Frontier will spend $4 million to expand its chlorine plant in Denver City, Tex.

German Chemical Imports Grow, Expansion Slows

During the first nine months of 1955, West German chemical imports swelled to 40% more than the previous year. On the other hand, expansion of chemical production and sales slowed. Total chemical industry sales were listed as $2.5 billion, a rise of only 14.4%, compared to the 18.6% rise for the nation's overall industry sales.

Imports reached 36% of German chemical exports, as compared with 27% in 1954 and 25% in 1953. German chemical circles fear that proposed West German import duty cuts will result in still larger imports, while West German exports of chemical goods are meeting with increasing difficulties in many markets abroad.

Imports of industrial chemical products accounted for the largest proportion of over-all chemical imports, more than $33 million in the first nine months of 1955, exceeding by 70% the corresponding figure for 1954. Tar dye imports increased by 60% to $5.3 million, of which about 90% came from Switzerland. Imports of rayon and staple fibers amounted to $19.5 million, against $16.6 million in the same period last year. Imports of plastics rose by 15% to $11 million in spite of the rapidly expanding West German productive capacity for plastics. Pharmaceutical imports, however, increased by only about 1% to $11.6 million, compared with an increase of 30% from 1953 to 1954.

More Reactor Elements, Uranium, Coming Up

Reaching out in several directions to promote growth of a private atomic energy industry, Atomic Energy Commission has recently:

- Awarded to Babcock & Wilcox Co. the first lump-sum contract to build reactor fuel elements in a privately owned facility.
- Given interested private firms until mid-1957 to come up with their proposals to construct and operate spent-fuel-element plants—the first not government-owned.
- Invited proposals for supplying up to 100,000 lb. per year of beryllium over a five-year period for atomic aircraft propulsion systems.
- Contracted with Continental Uranium, Inc., for the entire output of a new La Sal, Utah, uranium processing mill.

Babcock & Wilcox will complete this spring a Lynchburg, Va., plant which will turn out at least 325 fuel-element assemblies to replenish the core of the Materials Testing Reactor at Arco, Idaho. AEC wants private fissionable-waste recovery facilities in operation by 1960 to service the six private reactors already planned and others as yet unplanned. As for beryllium (current cost: $104 per lb.), the commission now gets its supply from a government-owned plant at Luckey, Ohio, which it will put on a standby basis if a private-plant proposal is accepted.

Other recent developments on the atomic front: Plans by Combustion Engineering, Inc., to build $5-million facilities in Windsor, Conn., for complete design and development of nuclear power reactors, for construction of reactor cores and for manufacture of related atomic fuel elements; a new AEC regulation covering licensing of persons responsible for handling the controls of reactors and other nuclear facilities used in the civilian atomic energy industry; an announcement by the organizing committee of last year's First International Exhibition on the Peaceful Uses of Atomic Energy that there will be a second such exhibition at Geneva this August.

News Briefs

Glycerine: Dow will substantially increase capacity of its 36-million-lb./yr. synthetic glycerine plant which started up only last summer at Velasco, Tex.

Petrochemicals: Commercial Solvents has announced plans to spend $10 million to expand its methanol and petrochemical derivatives facilities at Sterlington, La.

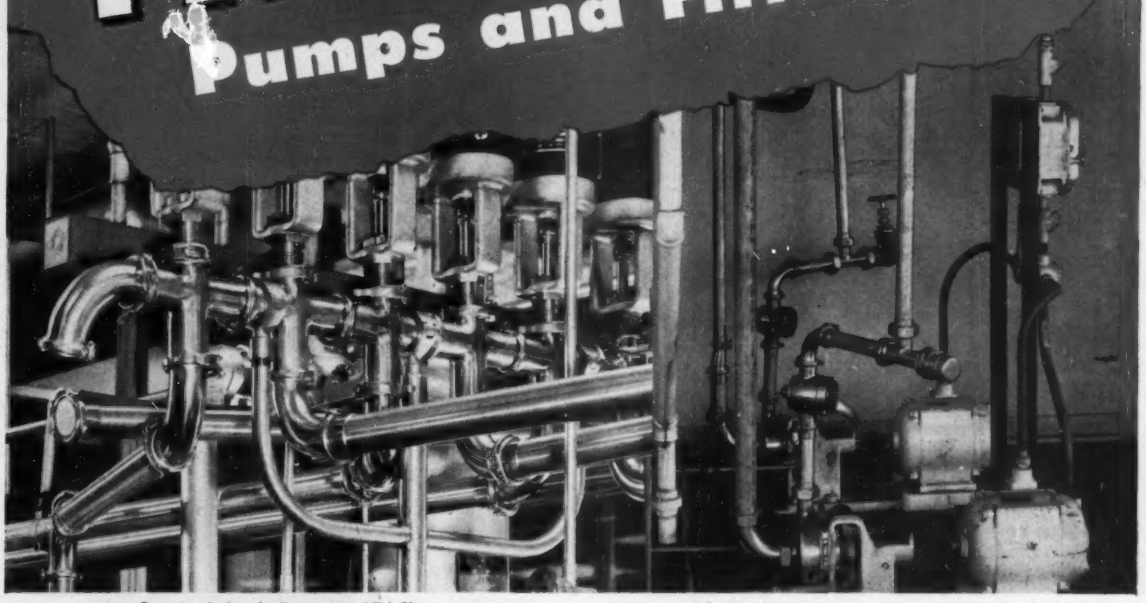
Epoxy resins: Shell Chemical Corp. has started up a new resin unit at its Houston plant to manufacture market-development quantities of new epoxy resins.

Phthalic anhydride: Monsanto Chemical Co. is expanding phthalic anhydride capacity at its Everett, Mass., plant to provide a 60 percent increase in the plant's output of the basic organic acid. Completion is set for early 1957.

Carbon black: Phillips Chemical Co. will build a new 64-million-lb./yr. carbon black plant in the Gulf Coast area.

Butadiene: Texas-U.S. Chemical Co., has just about completed construction on its Port Neches, Tex., butadiene and styrene plants which will expand combined capacity from 275 million to 350 million lb./yr.

Solve Corrosion Problems and Protect Product Quality . . . with TRI-CLOVER Pumps and Fittings



Battery of electrically-operated Tri-Clover compression valves with Tri-Clamp connections in a liquid conveying line.

A large midwestern processing plant employs these Tri-Clover centrifugal pumps and Tri-Clamp valves and fittings for handling corrosive liquids.

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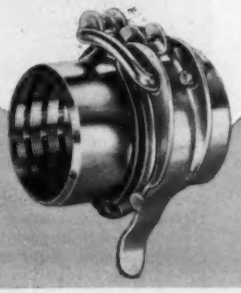
These are vital considerations when selecting pumps and fittings for chemical process service. Tri-Clover Division's constant research has developed exclusive design features that combine a high degree of corrosion-resistance with ease of assembly and disassembly . . . thus facilitating cleaning as well as allowing fast and economical changes in piping arrangements.

For pumping applications, Tri-Clover has a full line of centrifugal pumps designed to handle any product that will flow to them. A wide choice of seals are available, including inert carbon rotary seals for sanitary applications, packing gland seals, water cooled seals and seals for latex handling.

Tri-Clover stainless steel fittings of the sanitary type, with polished inside and outside surfaces, offer protection against corrosion and product contamination. They are available in threaded types or in the new Tri-Clamp design—no welding is required.

Let our engineering staff help you solve your liquid conveying problems. Write for descriptive literature.



The sanitary type Tri-Clamp union with snap-action spring clamp and toggle locking device is shown at the right. Available also with bolt type locking device in Schedule 5 pipe and Tube O.D. sizes in stainless with white pickle finish. Write for information.

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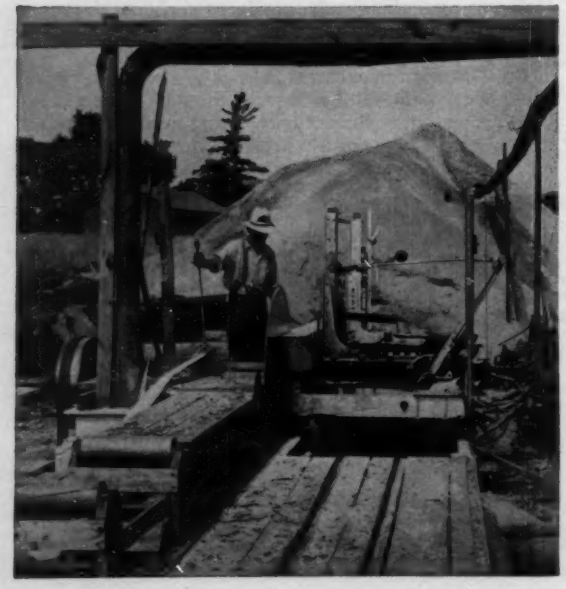
Life on the Chemical Newsfront

HE'S APPLYING TINY CHEMICAL "SHINGLES" to waterproof concrete. The spreading of water on a solid surface and the degree of wetting are determined by the contact angle between water and surface. Metallic stearates give large contact angles, causing water to be drawn up in drops, preventing wetting. AERO® Zinc Stearate, for example, forms very small leaflike plates or layers of adhering plates that repel water like shingles. To waterproof concrete, small amounts of zinc or other metallic stearate are added to cement clinker before grinding, to the concrete mix at time of hydration or are used in cement-water paints or sprays for coating concrete surfaces. **(Industrial Chemicals Division, Department B)**

®Trademark

THEY USED TO BURN IT, but now even the saw mill waste pile can be used. With Cyanamid's new MELURAC® Resin 304, wood-waste chips and sawdust can be converted to hardboard at a low temperature cure and short cure cycle. This melamine-urea-formaldehyde resin gives high flexural strength, high moisture and water resistance, and imparts no color to the board. The hardboard can be used for furniture cores, veneer bases and attractively textured wall panels, table tops and flooring. **(Plastics and Resins Division)**



VERSATILE THICKENER for aqueous systems, Cyanamid's water-soluble polymer, Polyacrylamide, is now available from new semi-commercial facilities. Polyacrylamide offers high thickening action and suspending power, excellent stability, uniform bulk density and particle size for rubber and paint latices, ceramic slips, metal cleaners, paper coating compounds, cements and adhesives. A white, free-flowing powder, Polyacrylamide is odorless and readily soluble in cold water to form solutions stable over a wide pH range. **(New Product Development Department B)**

Chemistry Makes Fashion News

Jacket courtesy Leather Industries of America

WHITE AND PASTEL LEATHERS are in fashion. They owe much of their favor to many fine quality features made possible by such chemicals as Cyanamid's new Leather Product 612. This new retanning agent, used for elk type and semisoft leathers, tightens the leather grain surface, and produces a fine low-grained leather with an excellent "break." It also adds fullness and roundness, building up loose-textured open areas in the skin. Leather Product 612 is one of many Cyanamid Dyes Department chemicals used by the leather industry. **(Organic Chemicals Division)**

MORE THAN THE DESIGNER'S SKILL goes into the graceful drape of modern fashions. It takes chemistry, too. CYANATEX® SB-100 Softener, for example, is a new specialty product that gives unusual softness and a smooth, silky "hand" to cotton and synthetic fibers. This softener is compatible with anionic and nonionic agents, starches and salts commonly used in textile finishing. It is extremely resistant to yellowing and scorching. In tightly woven or harsh fabrics, it imparts the lubricity needed for good sewing properties. CYANATEX SB-100 Softener is suggested for knit goods, starch finishes, broadcloth, dyed yarns, tufted spreads, percale sheeting, pillow tubing and all fabrics requiring good drape. **(Organic Chemicals Division)**

THIS MAZE OF PIPE and processing equipment is part of Cyanamid's new plant at Savannah, Georgia, which produces UNITANE® Titanium Dioxide. Twenty-two separate manufacturing steps are necessary to convert black ilmenite to brilliant white titanium dioxide. The whitest pigment yet developed commercially, titanium dioxide is whiter than snow and almost as white as pure magnesium oxide, the common standard used to rate whiteness. Made up of exceedingly fine crystals that reflect light, UNITANE Titanium Dioxide confers exceptional opacity as well as whiteness to paints, fine papers, white wall tires, plastics, vitreous enamels and dozens of other products of beauty and usefulness. **(Pigments Division)**

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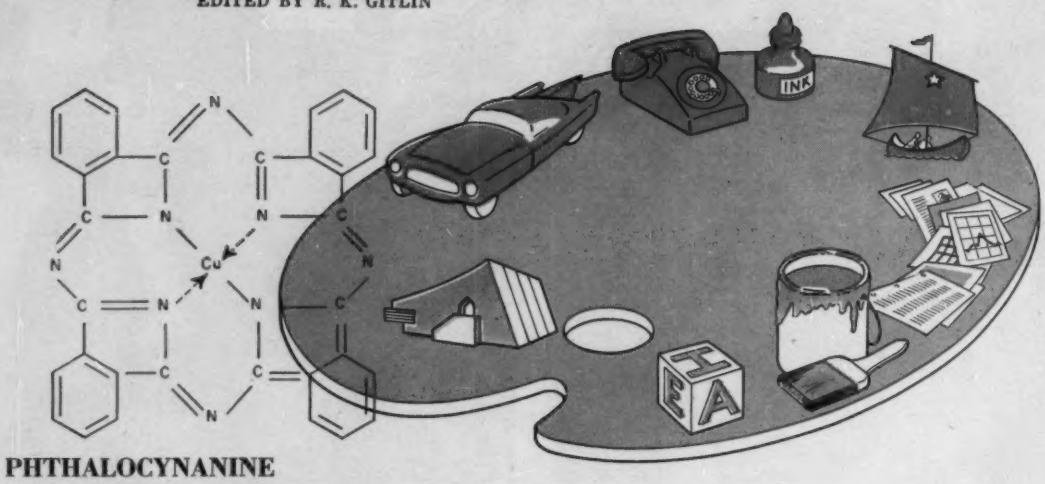
Additional information may be obtained by writing on your letterhead to the Division of American Cyanamid Company indicated in the captions.

Building for the Future Through Chemistry

EDITED BY R. K. GITLIN



PHTHALOCYNANINE

Rosy Outlook for Blues and Greens

Expanding color markets, new processing techniques and remarkable properties are key to the dramatic growth of phthalocyanine pigments.

What factors, in general, affect the growth of an industrial chemical? Certainly, increased demand, new and/or refined processing techniques, outstanding physical and chemical properties. And all of these, in combination, account for the fantastic growth of phthalocyanine pigments—ten-fold in ten years.

These remarkable blue and green pigments—with their extreme stability, light fastness and chemical inertness—are finding their way into a variety of consumer products, meeting stringent requirements which would-be competitors can't touch.

▶**Pie Split More Ways**—And capitalizing on this demand are many manufacturers who, ten years ago, had either a limited or no share of the market. For example, if you talked to pigment producers in 1945, the two names to crop up most often in conversation were Du Pont and General Aniline & Film. Today, however, you'd find that companies like Thomasset Colors, American Cyanamid, Imperial Color and Sherwin-Williams are all vying for sizable slices of the pie.

Perhaps the biggest single news this year will be an announcement, a follow-up of a 1955 news release, that Barrett Division of Allied Chem & Dye will be in commercial production of phthalonitrile, a vital intermediate for phthalocyanine pigment production.

Prior to 1942, imported phthalonitrile was the chief source of these pigments. But high costs necessitated a switch over to cheaper and readily available raw materials, phthalic anhydride and urea.

As a representative of one big pigment producer points out, if Barrett's price is right, the entire industry may upgrade production by going back to phthalonitrile as the starting material.

▶**Approach Ideal Colors**—Although phthalocyanine pigments are available both as metal and metal-free pigments, from a commercial viewpoint the important ones in the U. S. are the copper compounds.

Both the blues and greens possess outstanding light fastness, so much so that they're considered to be the closest things to truly permanent colors known to date. Added to their unusual stability, phthalocyanines are chemically inert to all except the most vigorous reagents. They're insoluble in water and all common organic solvents, have excellent heat stability.

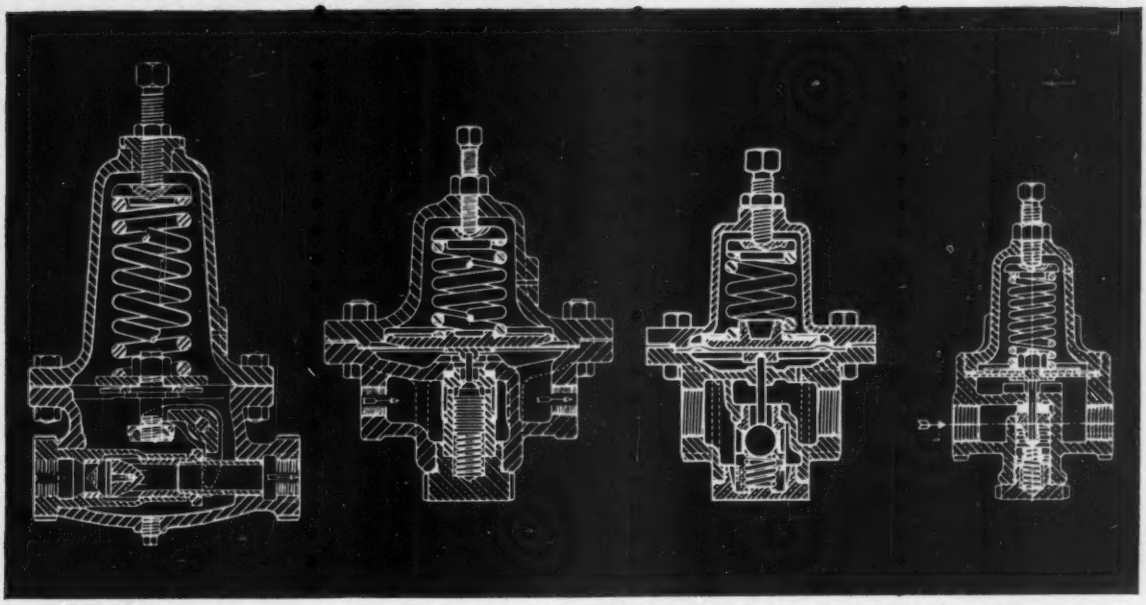
These physical and chemical properties are further enhanced by exceptional strength and color brilliancy. Phthalocyanine blue's tinting strength is about 1½ times stronger than iron blues, 15 times stronger than ultramarine and 2-5 times stronger than peacock blues. Phthalocyanine green is the only bright, high-strength green known with permanency to light exposure.

▶**How They're Made**—Phthalocyanine blue is currently manufactured by reacting phthalic anhydride (or substituted phthalic anhydrides) with urea (or urea derivatives) and a copper salt with a suitable

What's your pressure problem?

CASH STANDARD

has the answer...*or will find one!*



HERE ARE FOUR TYPES FOR MANY APPLICATIONS

TYPE 1000 — A streamlined, high capacity valve for close pressure regulation—accurate even under toughest working conditions. Closes against the flow, eliminating conditions that cause chatter. Sizes: ¼" to 2", screwed ends. Bulletin 962.

TYPE D — A general purpose regulator with exceptional regulation characteristics. Now improved to permit easier servicing but basically the same dependable valve offered for over 35 years. Sizes: ¼" to 2". Bulletin 950.

TYPE 1260 — A high capacity pressure regulator, small and well proportioned. Available with spherical, self-cleaning inner valve. Suitable for air, water, steam, oil and most fluids and gases. Sizes: ½", ¾", 1", screwed ends. Bulletin S-700.

TYPE 3381 — A small, compact, all-bronze pressure regulator, very accurate and dependable. Available with pressure gauge mounted in one of the two outlet connections. For small lines. Sizes: ¼" and ⅜", screwed ends. Bulletin 948.

There's a Cash Standard regulator for every pressure control problem!

For an individual solution to your control problem, contact the Cash Standard control specialist in your area, or write Dept. A.

CASH CS **STANDARD**

A. W. CASH COMPANY, P. O. Box 551, Decatur, Illinois

Pressure, Hydraulic, Temperature, Process and Combustion Controls

Newsworthy chemicals this month

Bright outlook for phthalocyanines.....138A
Citrus aniline dye.....140A
Plating additives 142A
Natural pearl essence from herrings.....142B
Oil well cement systems.....142C
Fire-resistant hydraulic lube.....144A
Moisture-proofing additive 144B
Long-chain epoxies 144C
Anionic surfactant 146A
Liquid phosphate feed.....146B
Single-distilled oleic acid.....146C
Fire-retardant acetate filament.....146D
Thermosetting insulating varnish.....146E
Alkyl aryl sulfonates.....146F
Fluorinated, resin-based paint.....146G

Page number is also Reader Service code number

For more about any item, use Reader Service Card

catalyst such as a molybdate or borate.

The green is made by reacting chlorine gas with copper phthalocyanine blue at relatively high temperatures in a chlorine-carrying medium—usually a eutectic mixture of sodium and aluminum chlorides.

Both blues and greens are processed to final pigment form by dissolving the crude colors in strong H_2SO_4 and drowning in water. The recovered washed press cakes are converted to a number of commercial standard forms suitable for specific applications.

Blue and green are sold as high-strength dry colors (toners) and extensions on various substrates such as rosinates, whiting, aluminum benzoates in dry form. Aqueous paste dispersions and colors flushed in oil are also made from presscake materials.

▶**These are Most Important**—Key pigments now on the markets (though new ones are coming out all the time) are:

• Phthalocyanine Blue B—Chlorine-free, red-shade blue in alpha crystalline form. This is the original phthalocyanine blue and is characterized by one important deficiency: It tends to recrystallize in strong organic solvent to the more stable beta form with loss of strength, redness and intensity.

• Phthalocyanine Blue BNC—Partially chlorinated copper phthalocyanine. Alpha phase, unlike regular Blue B, doesn't recrystallize in solvent.

• Phthalocyanine Blue BG (GT)—Beta phase, chlorine-free copper phthalocyanine. This is an intense green shade blue of peacock blue.

• Phthalocyanine Blue BNF—A flocculation-resistant form of Blue BG. Regular Phthalocyanine blues tend to separate in tint paints which presents some problems in applications like brushing paints. BNF grades made by special surface treatments or from mixtures of metal phthalocyanine other than copper phthalocyanines or with sulfonated phthalocyanines overcome this deficiency.

With minor exceptions, phthalocyanine blues and greens can be used for every industrial and artistic application. Major uses include industrial paint finishes, trade sale paint finishes, plastics, printing inks, floor coverings, leather finishes, paper coating and beater dyeing, solution dyeing of synthetic textile fibers.

▶**Costs Down**—Price picture has changed drastically since 1936, when phthalocyanine blue was first introduced in the U. S. In that year, cost per pound for high-strength color was $7.50. By 1945, the price was down to $3.50/lb. for high-strength blue and $4/lb. for green.

During post-war inflation, prices rose to $3.85/lb. and $4.40/lb., respectively. However, increased volume and processing techniques forced the selling price down. Current level is $3.45 for blue and $3.95 for green. **138A**

For More Information...

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Citrus Aniline Dye

Derived from waste citrus pulp, water soluble.

Efficient utilization of by-products, a universal industrial concept, may be partly realized by the citrus industry with the announcement that waste citrus pulp can now be used to make a water-soluble aniline dye.

The dye, a flavanone azo compound, is created by combining

Does HEYDEN HEXAMETHYLENETETRAMINE

Fit into YOUR process picture

SYNTHETIC RESINS
(Curing Agent)

MODIFIED PROTEINS
(Hardening Agent)

RUBBER
(Accelerator)

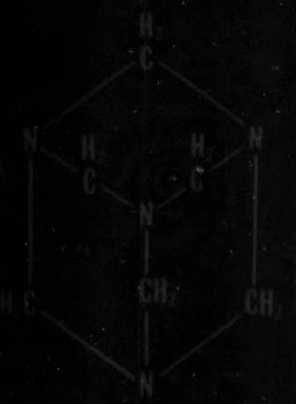
EXPLOSIVES
(Nitration Intermediate)

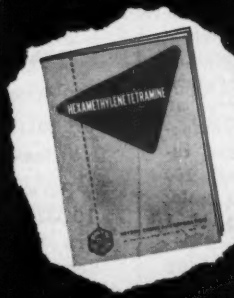
FUEL TABLETS
(Non-luminous flame)

MEDICINALS
(Antiseptics; intermediate)

PESTICIDES
(Weak base or buffer)

PETROLEUM PRODUCTS
(Buffer in catalyst manufacture. Phenolic complex former)





The unique physical and chemical properties of Hexamethylenetetramine have resulted in extensive and varied applications in industry. This versatile intermediate can serve as a tertiary amine or, when desired, react like formaldehyde. Many of its newer applications depend on its ability to act as a weak base or buffer.

Do you have a new application or a current process in which Heyden "Hexa" can be of help? If so, feel free to call upon our technical service department for assistance in choosing the proper form and grade to meet your requirements.

For the complete story, ask your Heyden representative, or write direct, for a copy of the new Technical Bulletin HEXA 1-55.

FINE HEYDEN CHEMICALS

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•
PARAFORMALDEHYDE

hesperetin or naringenin found in citrus pulp and waste with aniline or aniline bases. This combination provides an excellent stain composition which can be readily fixed (by either hot or cold aqueous solution) in cellulose pores of wood.

Advantages of citrus stain formulations include:

- Cheap and easy manufacture.
- Light fastness.
- Non-fading.
- Non-grain raising properties.
- Non-bleeding through lacquer or varnish top finishing coats.

Fillers can be mixed with the stain composition to make a combination stain and filler which has never before been possible—one which is transparent and fast to light.—**Chadeloid Corp., Dayton, Ohio.**
140A

Plating Additives

Key to new process which plates bright nickel twice as fast.

Newly developed addition agents — combinations of sulfonates and unsaturated alcohols—are credited with the success of a high-speed, bright nickel plating process called Levelume.

These additives make it possible to use an activated carbon pack in the filter for the plating solution. Results: continuous removal of harmful organic contaminants, eliminating costly and time-consuming batch purification.

Levelume process combines qualities of full brightness, high leveling and exceptional speed. It has shown deposition rates 100% higher than the fastest processes currently available. Added benefits include:

- Good ductility, controlled stress in either compressive or tensile side. Hence, no cracking, crazing, lifting or brittleness of deposits.
- Effectiveness over a wide current density range—from 20 to 150 amp. per sq. ft., compared with the usual 60 to 100 amp. per sq. ft.
- High leveling characteristics of the deposit fill in scratches to a degree which, in many cases, eliminates polishing and buffing for extra smoothness after plating.
- Deposits with high surface activity. Thus plated surfaces accept chromium and other deposits sans additional treatment.

Practically any existing nickel plating process can be converted to Levelume in a few days. No special auxiliary equipment is needed. Tanks only have to be cleaned and bleached.—**Hanson-Van Winkle-Munning Co., Matawan, N. J.**
142A

Herrings Move From Smorgasbord to Chemicals

Strange as it seems is the title for this one. The same herrings that grace hors d'oeuvres plates and smorgasbord tables supply the essential ingredient, guanine crystals, for natural pearl essence.

Herrings are pumped into small boats and, in the process, are descaled. Guanine crystals are then removed—intact—from the fatty skin which attaches them to the scales.

Briefly, processing involves three basic steps: (1) washing with a solvent, (2) centrifuging to separate crystals from liquid, (3) formulation — suspending crystals in a lacquer or plasticizer base. The trick is to retain guanine's original crystalline structure in the final product.

According to Mearl Corp., an East Coast essence manufacturer now developing pearl essence on the Pacific Coast, 100 tons of fish yield 1 ton of scale; 100 pounds of scale yield 1 pound of essence.

Natural essence—along with synthetic essence produced by Mearl — is commonly used in simulated pearls, nail polish, plastics and leather coatings.—Mearl Corp., New York, N. Y.
142B

Oil Well Cement Systems

Allow for control of density, thickening time, water loss in cementing slurries.

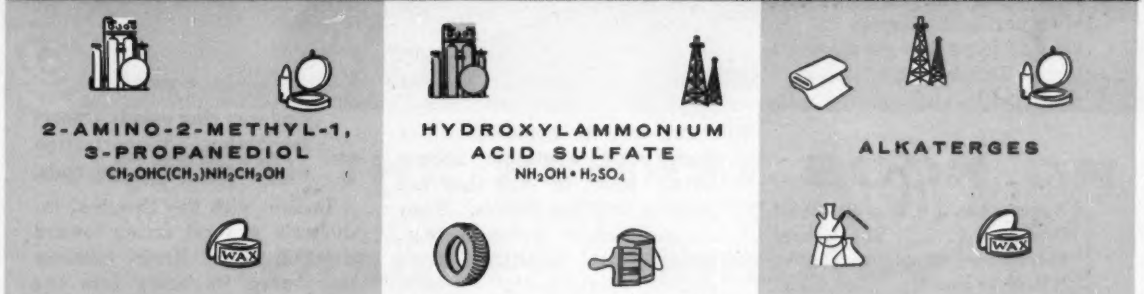
Successful cementing of a 16,531-ft. wildcat oil well (western Wyoming) under extreme temperature conditions is presented as proof that Diacel Cement Systems live up to the claims touted for them: Savings in cement and rig time; minimum fluid loss, channeling, flash; economical fill.

Sublette No. 1 well, with a

CSC NITROPARAFFINS

IMPROVING PROCESSES AND PRODUCTS

FOR AMERICA'S MAJOR INDUSTRIES



Nitroparaffins and their derivatives are economical, effective, versatile chemicals for such uses as solvents . . . prime ingredients . . . raw materials . . . sensitizers . . . emulsifiers . . . analytical reagents . . . reducing agents . . . inhibitors . . . short-stoppers . . . surface activants . . . dispersants . . . anti-foamants.

In a relatively short time, the members of the nitroparaffin family found wide use in many important industries.

New groups of derivatives are being studied continually for new and profitable applications. Steadily increasing quantities of these unusual chemicals are being shipped from CSC's plant in Sterlington, La.

Our Market Development team is ready to work with you in applying these outstanding products to your processes and products. Samples and technical data sheets are available on request.

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260 MADISON AVENUE **CORPORATION** NEW YORK 16, N. Y.

Baltimore 2, Md. • Boston 29, Mass. • Chicago 14, Ill. • Cincinnati 2, Ohio • Cleveland 13, Ohio • Detroit 7, Mich. • Los Angeles 22, Calif. Louisville 2, Ky. • New Orleans 12, La. • New York 16, N. Y. • St. Louis 17, Mo. • St. Paul 14, Minn. • San Francisco 4, Calif. IN CANADA: Reliance Chemicals, Ltd., Montreal. IN MEXICO: Comsolmex, S.A., Mexico 11, D. F.

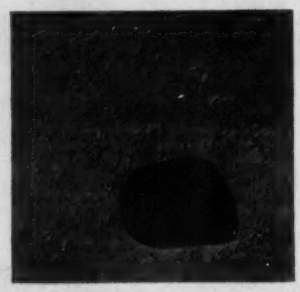
CSC INDUSTRIAL CHEMICALS

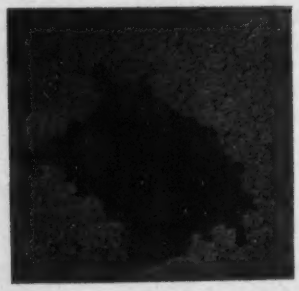
static bottomhole temperature of 235 F., was cemented in 35-deg.-below-zero weather with estimated total savings in cement and rig time of 20%. The job was done with a tailor-made system using two of the three Diacel additives in combination with common portland cement.

All three cement additives—Diacel D, Diacel LWL, Diacel A—permit a wide range of downhole conditions:

- Diacel D—Special grade of diatomaceous earth, permits formulation of low-density cements.
- Diacel LWL—Carboxymethyl hydroxyethyl cellulose controls water loss and retards thickening time of cement slurries.
- Diacel A—Special type of sodium silicate accelerator allowing placement of low water loss cements over a greater temperature range.

Diacels can be mixed with each other and added to common portland slurries to provide at least five separate systems.—**Drilling Specialties Co., Bartlesville, Okla.** 142C





Resin Additive Makes Concrete Impervious to Water

Addition of 2-4% Losorb, a moisture-proofing additive, permanently decreases—by about 50%—permeability of concrete blocks, mortar, plaster, etc.

Losorb, a hydrocarbon resin (low molecular weight polyindenes and polyolefins), also minimizes crack frequency; makes mix more plastic, easier to work; acts as a lubricant in molding; minimizes shrinkage in curing; prevents stucco from drying and cracking before concrete base cures thoroughly.

Industrial steel supported on Losorb-treated concrete is permanently protected from corrosion by moisture absorbed from the earth.—Pennsylvania Industrial Chemical Corp., Clairton, Pa. 144B

Appearance	Clear, oily liquid
Odor	Slight, mild
Ester value, % min	99
B.P. @ 10 mm. Hg.	509-545 F.
Volatility, 6 hr. @ 100 C. % max	0.1
Flash Point (ASTM D92-46)	455 F.
Fire Point (ASTM D92-46)	685 F.
Weight, lb/gal. @ 20 C.	9.54
Viscosity, SUS @ 100 F.	220
@ 210 F. (approx. min.)	42

Fire-Resistant Lube

Synthetic hydraulic fluid minimizes fire and explosion hazards.

Latest in a series of fire-resistant hydraulic fluids is Cellulube 220, the only safety fluid approved by the U. S. Navy for use in hydraulic systems of deck-edge elevators on aircraft carriers.

220 and its homologs differ from other synthetic fire-resistant lubes in that they are pure phosphate esters. They contain neither solvents (e.g., water) nor additives (e.g., glycols, antirusting agents, chlorinated hydrocarbons). Their pure chemical composition gives them an edge over their competition: They can withstand high-temperature hydraulic applications and can be reused once contaminants have been filtered out.

Cellulube 220 is a highly viscous fluid for general hydraulic service and special lubricant applications—as in air compressors. Its fire resistance greatly reduces hazards of explosions and fires associated with petroleum lubricants in compressed-air service while affording proper equipment lubrication.—**Celanese Corp. of America, New York 16, N. Y.** 144A

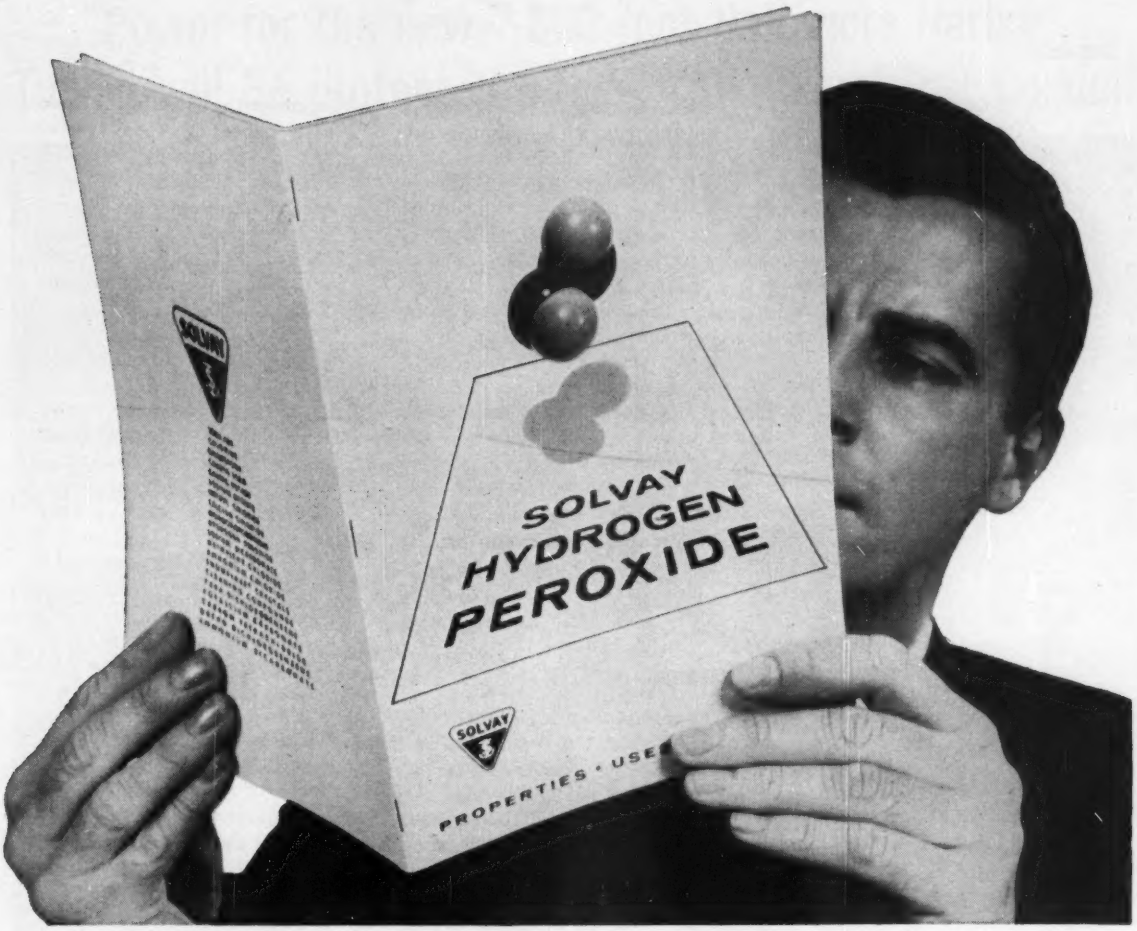
Long-Chain Epoxies

Undergo ring opening, polymerization, isomerization with active hydrogen cpds.

In line with the chemical industry's general trend toward diversification, Becco recently announced its entry into the epoxy market with three long-chain epoxidized olefins—octylene oxide, dodecene oxide and C_{16}-C_{18} olefin oxides.

Made via an improved in-situ epoxidation process (catalyst: ion exchange resin), the new products will undergo reactions such as polymerization, isomerization, reduction and ring opening with a variety of active hydrogen compounds. And they should be of great interest as:

- Reactive solvents and diluents for epoxy resins.
- Intermediates in manufacture of plastics, surfactants, lubricants, etc.
- Acid scavengers.
- Corrosion inhibitors.
- Stabilizers for chlorinated



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New 24-Page Book Gives You the Facts

Just off the press, this latest SOLVAY® factbook on hydrogen peroxide contains sections on physical properties, chemical reactions, uses, containers, handling and storage. The biggest section covers these important uses of SOLVAY Hydrogen Peroxide:

- Textile and Pulp Bleaching
- Synthesis of Organic Chemicals
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- Epoxidation
- Hydroxylation
- Oxygen Generation
- Foam Rubber
- Porous Structural Materials
- Polymerization Catalyst

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Potassium Carbonate • Calcium Chloride
Sodium Bicarbonate • Ammonium Chloride
Ammonium Bicarbonate • Caustic Potash • Chloroform
Sodium Nitrite • Caustic Soda • Methyl Chloride
Cleaning Compounds • Methylene Chloride • Monochlorobenzene
Para-dichlorobenzene • Ortho-dichlorobenzene • Hydrogen Peroxide

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Company _____

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City _____ Zone _____ State _____

AK-5

*In Western Hemisphere Countries.

compounds.

• Organic synthesis intermediates.

Becco is in a position to produce other olefin epoxides in the C_4-C_{24} series if enough interest in these should develop.—**Becco Chemical Div., Food Machinery and Chemical Corp., Buffalo, N. Y.** 144C

Anionic Surfactant

Formulated to reduce processing time, increase processing efficiency.

Isomal 265, an anionic liquid surfactant (sulfonated ester), has a lower surface tension than any other similar product and claims unmatched wetting and rewetting properties.

Said to have a broader range of solubility in water and nearly all organic solvents than ever before possible with any surfactant, 265 is easily dispersed in a variety of solvents—e.g., alcohol, acetone, petroleum solvents, oils and chlorinated solvents. And it's compatible with nonionic and other anionic agents. Additional points in its favor: Stable up to 210 F., no upper or lower cloud point.

Biggest uses for this 65% active anionic are anticipated in processing of industrial and agricultural chemicals—as an emulsifier for fats, waxes, oils agricultural sprays, insecticides.—**Chemical Div., Johnson-March Corp., Philadelphia, Pa.** 146A

Liquid Phosphate Feed

Replaces conventional solid form, cuts cost and labor.

A phosphate feed supplement known as "phosphate feed solution" is being offered as a cost- and labor-saving replacement for dry phosphates currently on the market.

Composition-wise, the liquid solution contains a minimum phosphorus content of 23.7%, compared with 18-21% for the solid. Costwise, unit price of phosphorus f.o.b. manufacturing point is $3.59—based on a sales price of $85/ton of new material. For the solid form, the unit price is $4. This means a saving of about $9/ton.

Only minor plant changes and relatively small capital investment are needed to switch over from conventional processes to the new method. All that's needed are storage facilities for the solution and pumping and metering devices for addition of correct amounts of material into the feed mixers.—**Inorganic Chemicals Div., Monsanto Chemical Co., St. Louis 4, Mo.** 146B

BRIEFS

Single-distilled oleic acid has been added to manufacturer's line of fatty acids and derivatives. New grade, Emersol 213 Low Titer Elaine, is identical to the standard 211 Low Titer Elaine, but is lighter in color. Price of 213 is equal to that of standard 211.—**Emery Industries, Inc., Cincinnati 2, Ohio.** 146C

Fire-retardant acetate filament yarn in both natural and solution-dyed colors is available for a wide variety of uses. Major consumption, to date, has been in the manufacture of dolls' wigs. But promising applications, where fire resistance is important, are expected to include transportation fabrics and decorative fabrics for home, office and public places. — **Celanese Corp. of America, New York 16, N. Y.** 146D

For More Information...

about any item in this department, circle its code number on the Reader Service

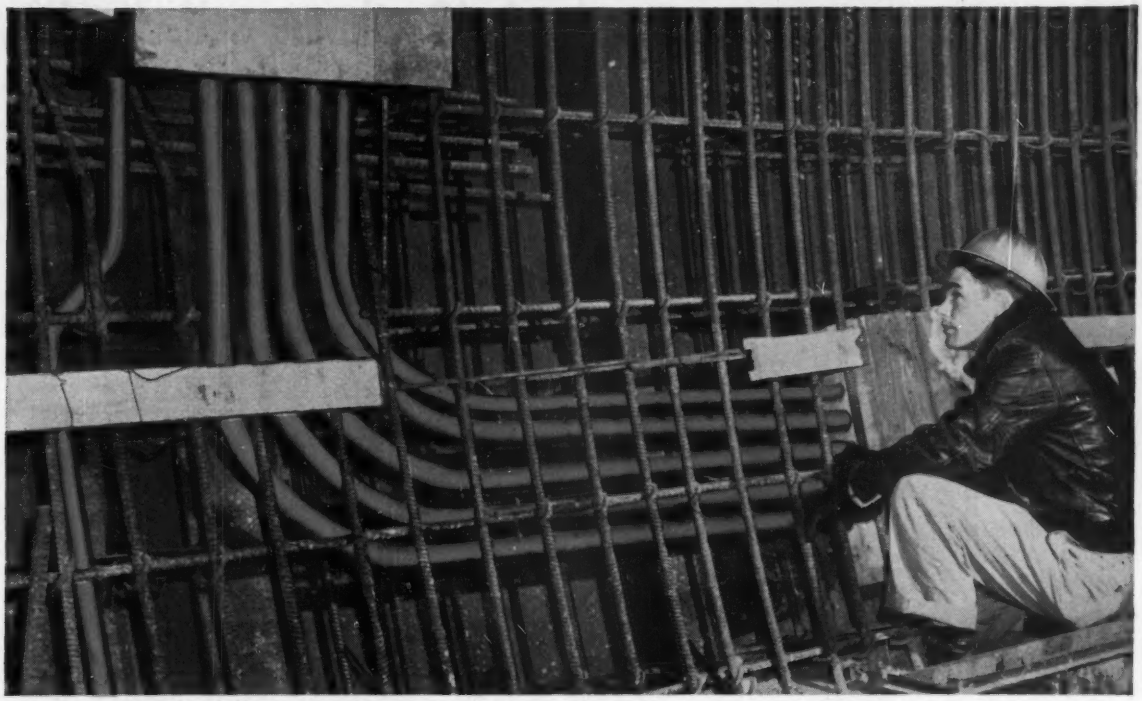
Postcard inside the back cover.

Thermosetting insulating varnish based on epoxy resins has exceptional electrical insulation endurance in presence of chemical atmospheres, moisture, radical temperature changes (from −55 to +200 C.). Known as Thermopoxy T-653-LB, the varnish cures throughout on exposure to baking temperatures of 135-150 C. And upon curing, it develops a coating having exceptional adhesive and bonding strength.—**Sterling Varnish Co., Haysville Borough, Sewickley, Pa.** 146E

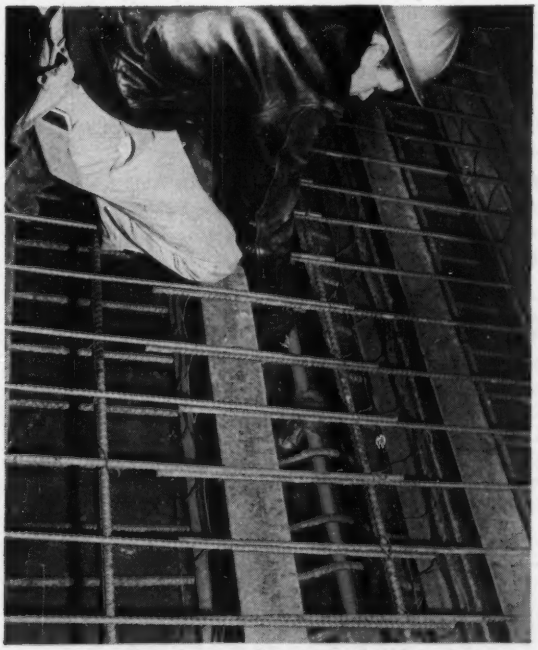
Alkyl aryl sulfonates available in a wide range of molecular weights make possible the selection of a sulfonate with the proper hydrophobe and hydrophile balance for any given application. Molecular weights range from 208 (sodium xylene sulfonate) at the low end of the scale to 480 (oil-soluble amine sulfonates) at the high end. Water-soluble Ninex compounds are used as coupling agents, foamers, etc. Oil-soluble Ninates serve as water-in-oil emulsifiers, corrosion inhibitors for oils or gasoline, drilling mud additives. — **Ninol Laboratories, Inc., Chicago 16, Ill.** 146F

Fluorinated resin-based paint, Lankote Fluoro-B, is said to possess unusual corrosion resistance, protects metal and wood surfaces from highly concentrated alkalis and acids (e.g., fuming HNO_3). Compared with ordinary paints, Fluoro-B will cover a smaller area (about 250 sq. ft. per gal.), but won't fail under severe corrosive conditions. Once applied, paint dries in a few minutes, needs no baking for its unique properties to become effective. Price—believed to be highest in the world—is $36/gal. in quantity, $40/gal. for small lots.—**Lankote Div., J. Landau Co., Carlstadt, N. J.** 146G

Power for the new 7,650-foot Baltimore Harbor Tunnel will be protected by EVERDUR Electrical Conduit



Everdur Electrical Conduit, nominal size 1½", connecting control box to sidewalk manhole—all conduit to be embedded in concrete.



A section of Everdur Conduit in the roadbed slab protects the vital traffic control system and air duct lighting.

THE BALTIMORE HARBOR TUNNEL†, under the Patapsco River, scheduled for completion in 1957, will be the largest "trench-type" tunnel ever built. Twin-tube sections are built on dry land, launched and concreted almost to zero buoyancy, then sunk in place and joined underwater by divers.

Power for traffic signals, alarms, air duct lighting, and shaft lighting circuits for this great tunnel will be protected by Everdur* Electrical Conduit—made from one of Anaconda's copper-silicon alloys. Everdur never rusts—offers high resistance to other types of corrosion. It provides dependable year-after-year protection—wherever water and corrosive atmospheres are a problem—or where conduit must be buried or embedded in concrete. Everdur is also tough—stands up under movement and vibration.

For detailed information, write: The American Brass Company, Buffalo Division, Buffalo 5, New York. In Canada: Anaconda American Brass Limited, New Toronto, Ontario.

*Reg. U.S. Pat. Off. 56134

†Built by Maryland State Roads Commission; Merritt-Chapman & Scott Corp., General Contractors; Singstad & Baillie, Contracting Engineer; J. E. Greiner Co., Consulting Engineer.

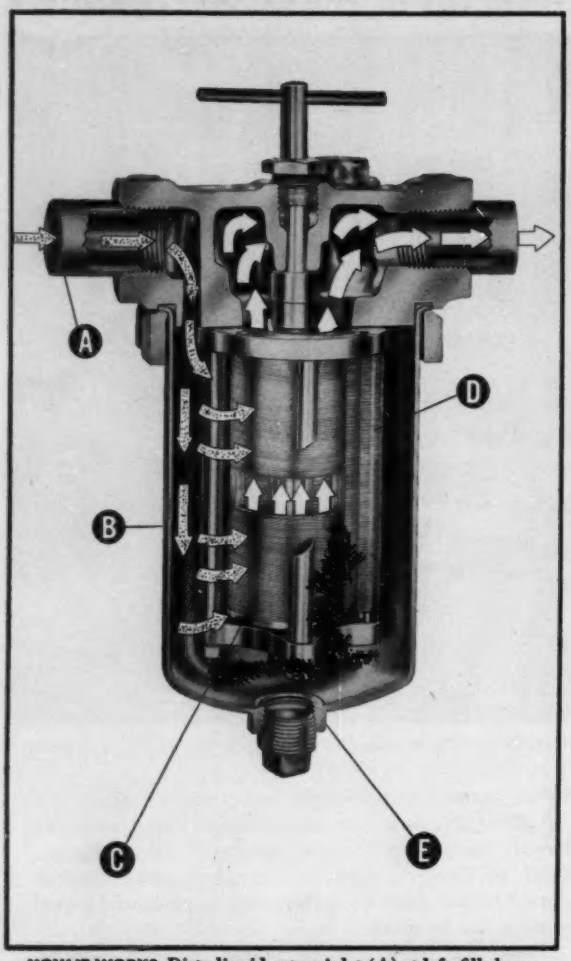
EVERDUR ELECTRICAL CONDUIT

ANACONDA®

COPPER-SILICON ALLOYS

CORROSION-RESISTANT • STRONG • NONMAGNETIC • WORKABLE • WELDABLE

New! CUNO SUPER Auto-Klean Filter



HOW IT WORKS. Dirty liquid enters inlet (A) at left, fills housing (B) and flows through metal edge-type filter (C). Clean liquid rises through center of filter, leaves at right. Dirt combed out by cleaner blades (D) is removed through drain (E).

A 40-micron, self-cleaning filter for process liquids

...and you can clean this filter by simply turning the handle!

Many times smaller than other micronic filters of equal capacity, Cuno's new SUPER Auto-Klean filter now makes possible economical, micronic filtration at high flow rates and eliminates the need for replacement cartridges. Here's what SUPER Auto-Klean offers process industries:

1. *Micronic filtration* with a self-cleaning filter. Just turn handle to clean—continuously with motor drive or intermittently by hand.
2. *Eliminates cartridge changes.* Ends operating costs if you've been using cartridge filters.
3. *No pressure-drop build up.* An 8-in. long, 2¼-in. diameter cartridge handles 30 gpm of liquid at 50-centipoise viscosity with only 3-psi pressure drop—up to 75% more with a slightly higher pressure drop.
4. *Positive protection* against solid particles larger than 40 microns (actually 0.0015-in.). Can't rupture or channel.
5. *Much smaller* than replaceable-cartridge-type filters of equal capacity, you save on lower initial costs, lower installation costs, lower space requirements than for cartridge units. You get high capacity in a small package.
6. *No duplex units needed.* Handles full flow all the time with no interruptions for cleaning.
7. *SUPER Auto-Klean* fits existing Cuno Auto-Klean housings. You can easily replace most 2¼-in. diameter cartridges with SUPER Auto-Klean for finer filtration.
8. *SUPER Auto-Klean* is available in all-steel or type-316-stainless-steel construction with Teflon seal.

WRITE TODAY for your copy of SUPER Auto-Klean Catalog SAK-057 or discuss your specific process application with our engineers. Cuno Engineering Corporation, 3-5 South Vine Street, Meriden, Conn. 5.10

Typical SUPER Auto-Klean installations

1. 50 gpm of organic solution, viscosity 100 to 130 cps at 80°C operating temperature and 125-psi operating pressure—40-micron filtration.
2. 1.2 gpm of polyethylene, viscosity 50,000 cps at 340°F, operating pressure of 2,000 psi and pressure drop of 800 to 900 psi—40-micron filtration.
3. 10 gpm of resin, 2,000 SSU at 500°F and 100-psi operating pressure—40-micron filtration.
4. 10 gpm of printing ink—40-micron filtration.
5. 20 gpm of coating liquid—40-micron filtration.
6. Phenolic water at 125-psi operating pressure on pumps—40-micron filtration.
7. 150 gpm of wax—40-micron filtration.

Ideal for in-line installation before pre-coat filters.

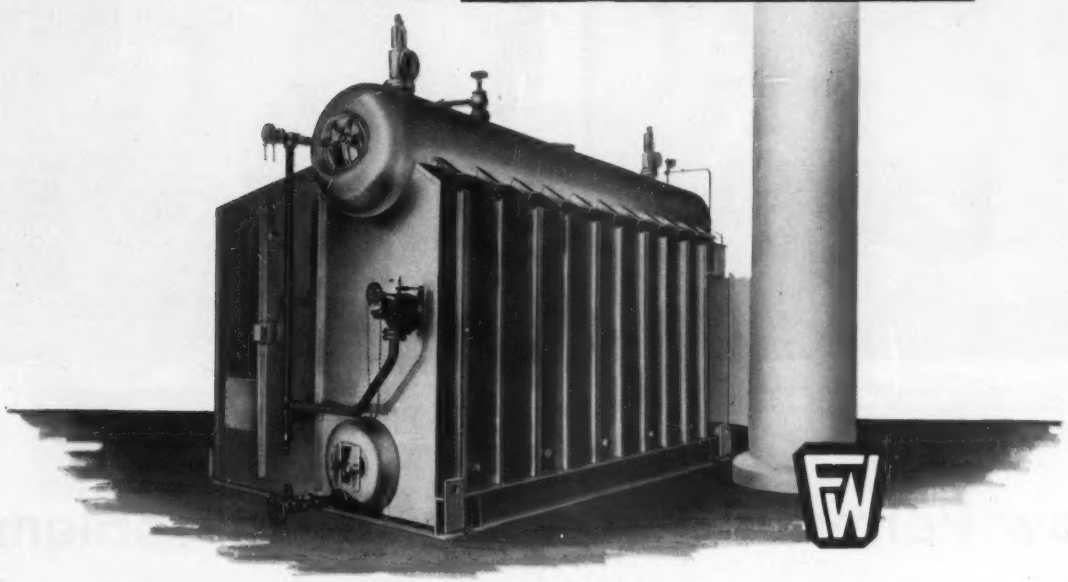
CUNO

ENGINEERED FILTRATION

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (edge-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound) • PORO-KLEAN (porous stainless steel)

CUT STEAM-PLANT INSTALLATION AND MAINTENANCE COSTS

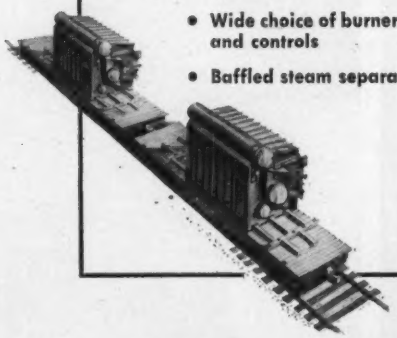


. . . with the NEW Foster Wheeler

PACKAGED STEAM GENERATOR

CONSTRUCTION FEATURES

- 36″ steam drum and 24″ water drum
- Staggered boiler tube arrangements
- Closely spaced waterwall tubes
- Water cooled target wall
- No headers—Low circulation loss
- Light, highly efficient refractory and insulation
- Wide choice of burners and controls
- Baffled steam separator



HERE IS a compact, space-saving steam generator that is completely factory assembled and shipped to you ready to set on a simple, low-cost foundation—ready for your fuel, steam and electric connections. There is only one outlet to the stack, and this has a simple, flanged connection as shown above. Extremely compact design permits access to boiler rooms through average building openings.

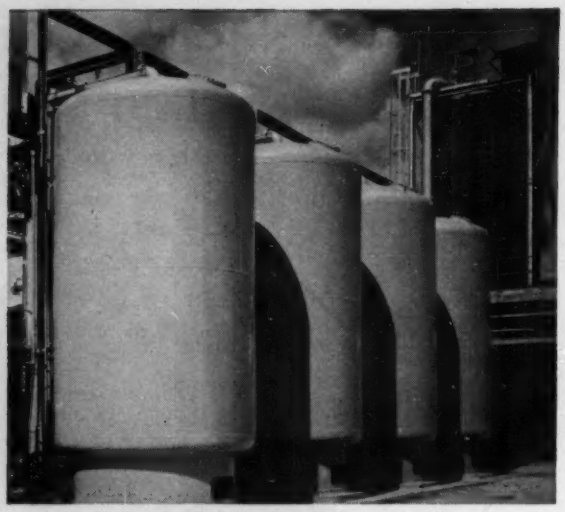
Low refractory maintenance is assured by the use of closely-spaced waterwall tubes and water-cooled target wall. The boiler interior is easily accessible for cleaning through a large access door in the rear furnace wall, and dusting ports are provided along the boiler bank side at intervals of not more than 42″. Soot blowers can be furnished as original equipment or installed later.

Available in capacities from 10,000 to 50,000 lb/hr, the *new* FW Packaged Steam Generator represents the last word in modern steam plant design. For complete details, send for Bulletin PG-55-3. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

ENGINEERING. Permutit engineers work with your staff or your consulting engineers to design all or any part of your water conditioning system.



EQUIPMENT. Permutit supplies complete equipment. Critical parts such as valves, chemical feeders and controls are designed and made by Permutit.

How Permutit® Solves a Water Problem

U. S. industry is faced with using lower grade water. Results: possible boiler scale, turbine deposits, corrosion of pumps and piping . . . also stains, blisters and other problems in plating, rinsing, dyeing and chemical processing.

• **For expert answers,** more and more management men and their consultants are buying the complete service offered by leading water-conditioning firms. Here's how Permutit (rhymes with "compute it"), a pioneer and largest in the field, tackles a water problem:

• **Water analysis,** study of the problem and past experience provide data on possible methods of treatment. The process offering the best balance of initial and operating cost vs desired quality of treated water is selected.

• **Complete proposal** by Permutit engineers covers type, size and capacity of equipment, price, any special engineering services and performance guarantees.

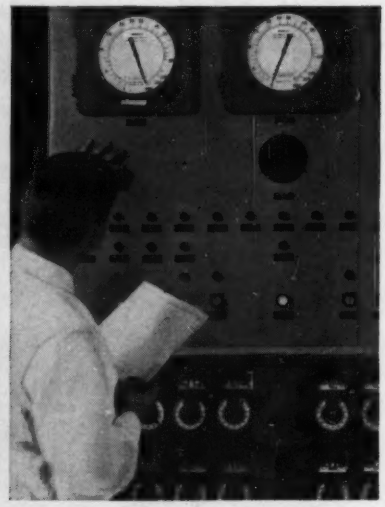
• **Manufacturing** – After the proposal is accepted, Permutit designs the entire project, schedules assembly and shipping. Critical parts, ion exchange resins, control panels are all made in Permutit plants. (No other U. S. firm makes all these components.)

• **Test runs** – Where required, Permutit checks the installation, supervises start-up and initial operation, trains permanent operating personnel.

• **For further information** look up the Permutit office in your city or write to The Permutit Company, Dept. CE-5, 330 West 42nd St., New York 36, N. Y.

WATER ANALYSIS. Permutit's modern water-analysis laboratory tests over 1200 samples a month!

ION EXCHANGE RESINS. Permutit makes its own ion exchange resins, natural and synthetic zeolites.



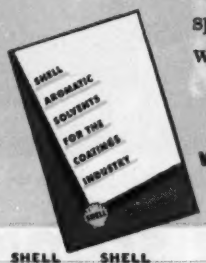
AUTOMATIC CONTROLS to ensure optimum results are designed, assembled, wired and tested by Permutit.

For surface finish formulation . . .

SHELL AROMATIC SOLVENTS

with wide variety of evaporation ranges

These Shell solvents cover a very wide evaporation range. Their individual characteristics satisfy specific requirements in a great variety of formulations. Detailed specifications are given in a booklet which will be sent upon request.



Write for your copy.

SHELL TOLUENE

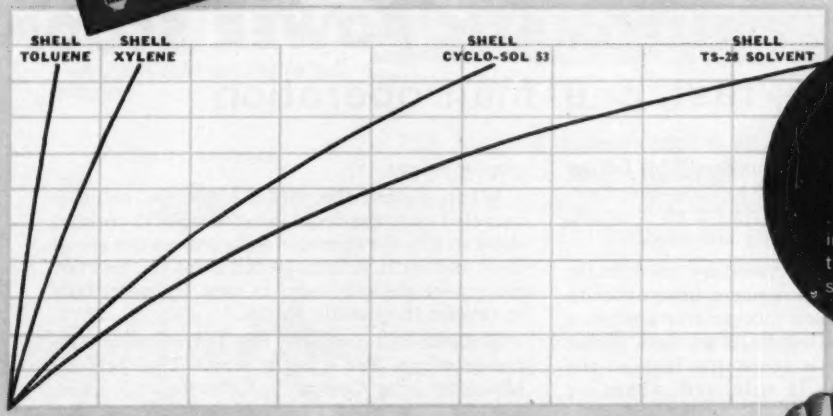
. . . for applications where very fast evaporation and high solvency are required.

SHELL XYLENE

. . . has an exceptionally narrow distillation range, is slower drying than toluene.

SHELL CYCLO-SOL 53

. . . an excellent solvent with higher flash point and slower evaporation than xylene.



SHELL TS-28 SOLVENT

. . . a still slower drying aromatic concentrate of medium high solvency.

SHELL OIL COMPANY

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100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA

SHELL

To unload bulk materials from box cars...

THE JEFFREY AUTOMATIC POWER SCOOP

safe, fast, one-man operation

Save man-hours unloading box cars! This Jeffrey scoop cuts unloading time 30 to 50%—one operator can empty a box car in 2 to 3 hours, depending on material being unloaded.

This scoop is easily operated by one man, as it is light in weight and requires little effort to pull backward. Forward motion starts when a button built into the handle is pressed, giving positive control. But it stops the instant the grip on the handle is released, assuring greater safety.

When pulling the scoop back, the cable is unreeled only the required distance. There's no slack to trip the operator as he moves the scoop back and forth. A limit switch stops the forward motion at the car door, in case the man fails to release the handle switch.

Bulletin 863 describes the Jeffrey automatic power scoop. For a copy, write The Jeffrey Manufacturing Company, Columbus 16, Ohio.

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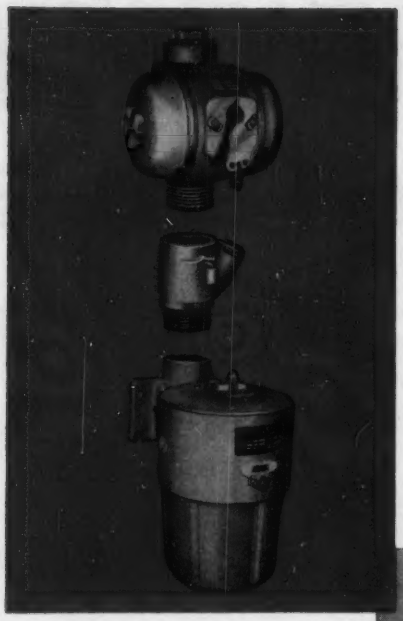
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

JEFFREY



For complete protection... against explosion, dust, rain... use

APPLETON

INDUSTRY'S MOST ADVANCED LINE

Circuit Breaker, Motor Starter and Combination Motor Starter

UNILETS®

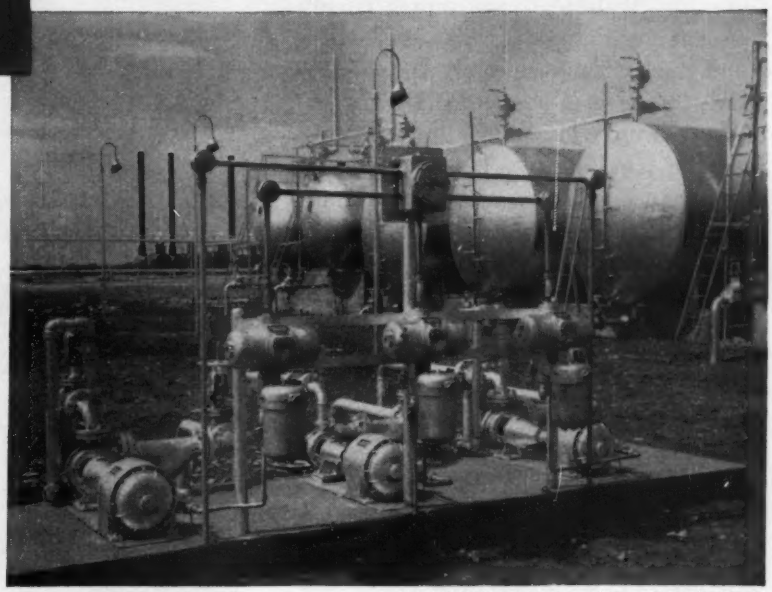


Photo courtesy Oil & Gas Journal

APPLETON Circuit Breaker and Motor Starter Unilets on tank car loading pump motors in field processing plant.

More TOP-QUALITY features!

- First to be U.L. Approved for banked circuit breaker grouping
- Combinations meet U.L. requirements through approval of components
- No shut-downs while entering motor starter of a combination
- Full 7-thread Explosion-Proof protection
- Unmatched accessibility
- Compact, lightweight construction
- Units may be added quickly, easily
- Flexible field set-ups with single and duplex male and female hub adapters

Also Manufacturers of:

The biggest advancement in Explosion-Proof design in years! The design, construction and performance of APPLETON Circuit Breaker and Motor Starter Unilets give you maximum safety and unparalleled ease of wiring, installation and maintenance. You'll discover initial and long term savings plus many exclusive APPLETON features, not found in any other enclosure.

Where absolute safety is required, regardless of the installation, APPLETON can serve you better! Send for Bulletin BH today for complete information!

Sold Exclusively Through Selected Wholesalers

APPLETON ELECTRIC COMPANY
1742 Wellington Avenue • Chicago 13, Illinois

Rely on* APPLETON ... *the Standard for Better Wiring

EVEN SULPHURIC ACID

Hewitt-Robins Maltese Cross

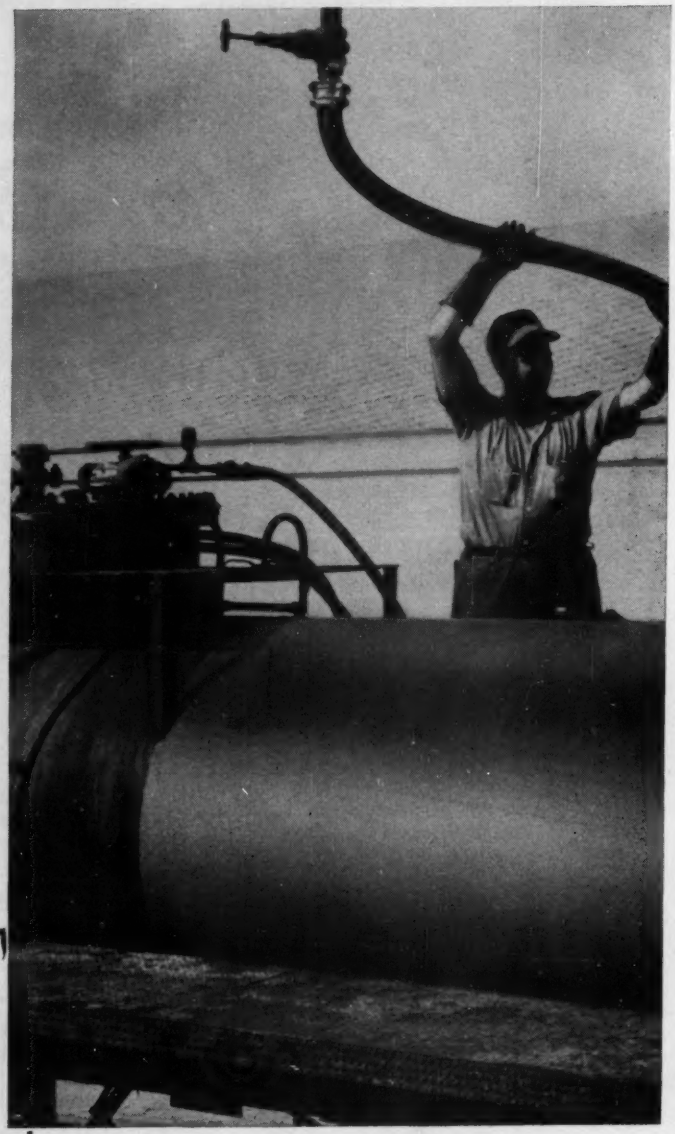
For more than three years, this length of Hewitt-Robins Maltese Cross *Hypalon* Hose has been conveying sulphuric acid from delivery truck to storage tank for Reading Batteries, Reading, Pennsylvania.

The job called for a flexible, rugged hose because of the difficulty of positioning the trucks directly beneath rigid piping. Highly resistant hose lining was necessary to withstand the corrosive action of the fluid. A sturdy cover was demanded by the extremes of winter-to-summer temperatures. Speed in handling was required because demurrage charges are made if the transfer consumes more than an hour.

All these needs were satisfied by Maltese Cross *Hypalon* Acid Hose, lined with Du Pont's acid resistant *Hypalon*. In its three years of service the hose has been undamaged either by the acid or by the weather. The flexibility of the hose and its ease of handling have cut unloading time for trucks to a minimum.

Hewitt-Robins Maltese Cross *Hypalon* Acid Hose is "the answer to our problem," says Mr. L. F. Groff, Director of Procurement for Reading Batteries.

*Reg. T. M. Du Pont Company HYPALON chemical rubber.



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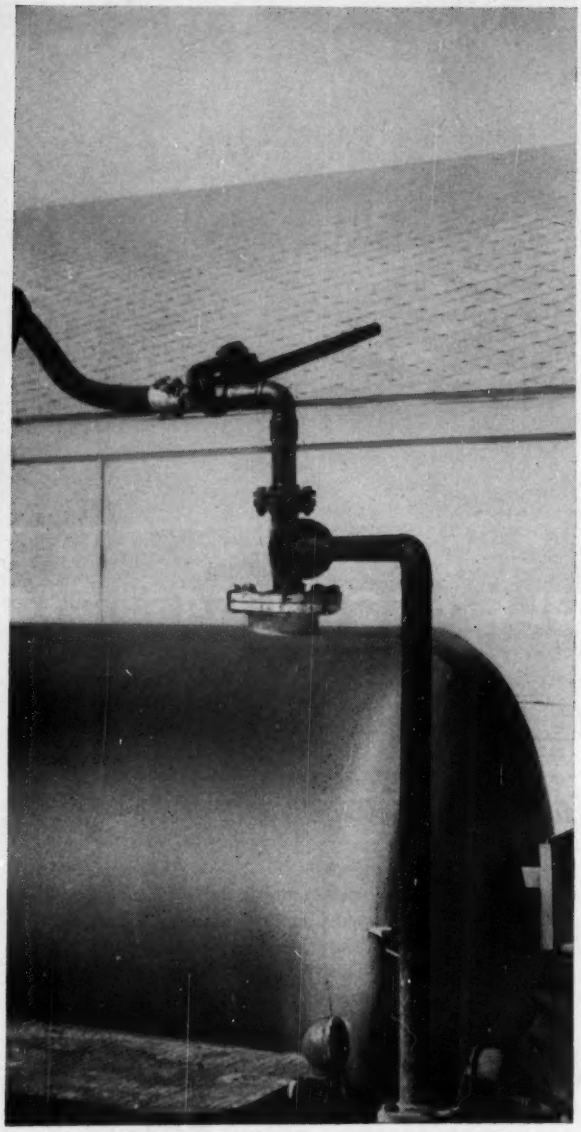
"GLIDE RIDE" THE NEW MOVING SIDEWALK

HEWITT
INCORPORATED • EXECUTIVE

WON'T HARM

*Hypalon** Hose



ENGINEERING DATA
HEWITT-ROBINS
MALTESE CROSS HYPALON HOSE

Hewitt-Robins acid-conducting Maltese Cross *Hypalon* Hose is particularly recommended for the following services:

	Maximum Concentration	Maximum Temperature
Chromic Acid	100%	150° F.
Nitric Acid	70%	70° F.
Nitric Acid	10%	70° F.
Sulphuric Acid	96%	70° F.
Phosphoric Acid	85%	200° F.

TUBE. *Hypalon*, a synthetic polymer which has high resistance to many acids and chemicals for which no recommendation had been heretofore possible.

CARCASS. High burst-resistance assured by multiple plies of high-tensile fabric. Special weave gives added flexibility. So do insulating layers of thick rubber bonded between the plies.

COVER. Made of pure gum rubber to resist acids, alkalies and chemicals. Tough to withstand abrasion. Ends are protected by thick rubber caps to prevent liquids from penetrating into carcass.

SIZES AVAILABLE. Lengths up to 50 feet. Inside diameters from ½" to 3" in eight sizes. Most sizes 4 plies; some sizes available in 5 plies. Varying working pressures—up to 200 lbs. in some sizes. Furnished with straight ends only.

FOR SERVICE AND INFORMATION
ON BELTING AND HOSE
CALL YOUR LOCAL HEWITT-ROBINS
INDUSTRIAL SUPPLY DISTRIBUTOR
LISTED IN THE "YELLOW PAGES"

-ROBINS

OFFICES: STAMFORD, CONN.

at the 7th National Plastics Show!

Vinyl tells an exciting story about the future of your product at the Firestone Exon Booth No. 813-815.

In this exhibit of Exon, industry's most complete source of vinyl resins, you will discover how many new ways vinyl will enrich your product —and your profit picture.

Of very special note is a new and highly promising use of that remarkable plastisol resin, Exon 654. The new development, VINYLFOAM, has been proved outstanding in cushioning, safety, utility and economy.

This is new and dramatic evidence of the plastics industry's limitless opportunities, particularly in vinyl.

We expect Exon 654, with all its exceptional properties, to play a major role in its advancement . . . as all Exon resins are contributing to the growing significance of plastic in industrial and consumer life.

We invite you to be our guest.

SPE 7th National Plastics exposition new York Coliseum June 11-15 1956

Firestone ..... EXON ..... **CHEMICAL SALES DIVISION**

FIRESTONE PLASTICS COMPANY, POTTSTOWN, PA.
DIVISION OF THE FIRESTONE TIRE & RUBBER CO.

TRACTOMOTIVE TL-10 TRACTO-LOADER

Capacity — 1 cu yd
Horsepower — 63
Reach — 2 ft, 7½ in. (at 8-ft dumping clearance)
Weight — 11,700 lb

. . . in this low carry position the load is "tucked in" close to the cowl.

LOW CARRY . . . SHORT TURNING . . . HIGH LIFT

More output on every materials handling job

You can scoop up a heaping load and carry it low without spilling with the Tractomotive tip-back bucket. In this low carry position, the load is "tucked in" close to the cowl for better balance and visibility . . . easier maneuvering. Short turning radius enables the TL-10 to turn from a 9-ft aisle into a 10-ft bin without jockeying. It easily loads into high dump bodies or hoppers . . . and there's *extra long reach* because tires do not extend ahead of cowl. But these are just a few of many TL-10 advantages.

Hydraulic torque converter drive lets you crowd steadily into the pile — engine torque is multiplied three times. Tip-back feature gives a scooping action that fairly tumbles material into bucket. With clutch-type transmission, you pull a lever and move away from the pile on the double without time out for shifting. Reverse is almost twice as fast as forward. Bucket over drive wheels utilizes weight of loaded bucket for greater traction while it eases weight on rear wheels for easier steering.

Make an appointment for a demonstration. See how these big-production features will help you increase output.

SOLD AND SERVICED BY YOUR ALLIS-CHALMERS CONSTRUCTION MACHINERY DEALER

Send for Free Descriptive Catalog on the Complete Line of Tracto-Loaders

TRACTOMOTIVE

TRACTOMOTIVE CORPORATION • DEERFIELD, ILLINOIS

TRACTOMOTIVE CORP., Dept. CN
Deerfield, Illinois

☐ Please arrange a demonstration of TL-10.
☐ Send Catalog.

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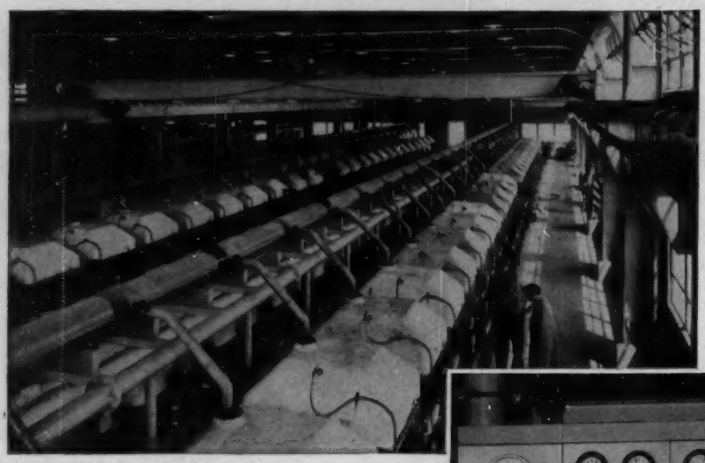
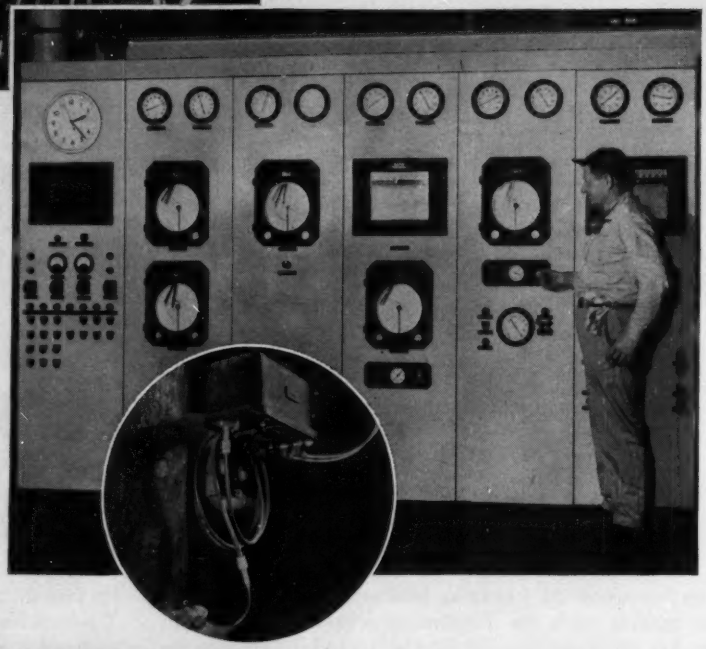
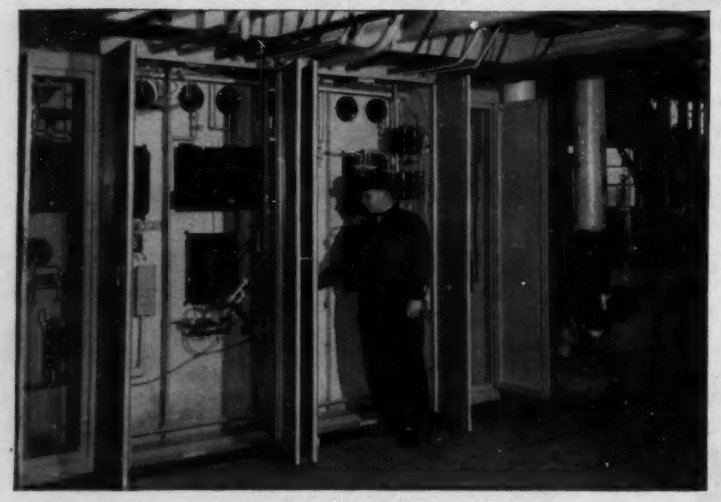
Hooker Chlorine and Caustic



Chlorine-caustic soda cell room, showing Hooker's modern Type S-3A electrolytic cells. The Hooker cell is licensed to other companies throughout the world, and, with modifications, produces more chlorine than any other type cell in the world. The cell design lends itself to excellent controllability.



Chlorine Panel Board. In general, each major process area has its own central control panel, since the use of a single control panel for all units is not practical in a chlorine-caustic plant. Inset picture shows TRANSAIRE Temperature Transmitter on chlorine desuperheater.



Rear view of Chlorine Panel Board. Note instrument and electrical conduit runs above the board, making for rigidity, simplicity and ease of maintenance. Tubing runs are ¼" or ⅜" OD polyethylene with 1/32" walls placed inside conduits. Where practical, tubing is in one continuous length.

★ ★ ★

Your Taylor Field Engineer is fully qualified to advise you on your instrumentation problems. Or write to Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

*Reg. U.S. Pat. Off.

Production relies on Taylor at Montague Plant

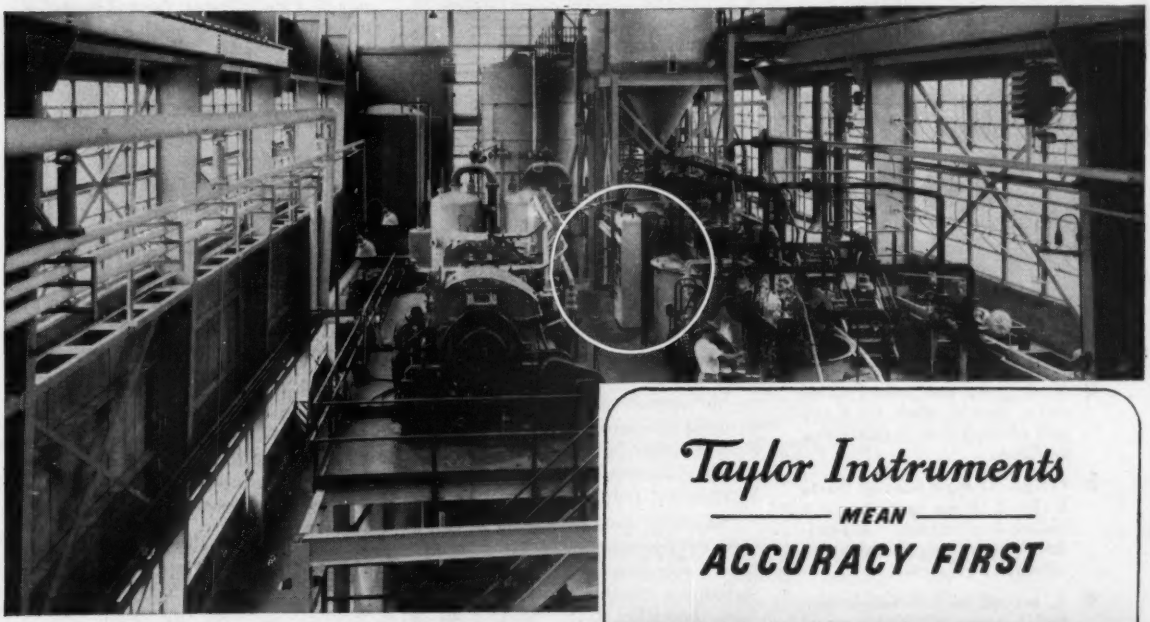
IN the production of chlorine and caustic soda, pressure is one of the most important variables. Control is critical, because the effects are instantly reflected in the rest of the process if pressures become unbalanced. At Hooker's new Montague, Michigan, plant, the process is stabilized by controlling the pressures at two points—cell suction and back pressure on the blow gas recovery system. Control of the latter pressure also holds a uniform pressure on the liquefiers.

In controlling cell suction, fast speed of response is imperative. For this reason, the process piping was designed so that the pressure transmitter, the controller and the control valve are grouped close together. Two complete control systems are installed in parallel, one acting as an installed spare. Outputs of both transmitters are relayed to the control panel, where each is recorded. There are also individual setpoint stations for each controller. Control can be switched from one instrument to the other from the panel. Back pressure on the blow gas recovery system is controlled by a panel mounted FULSCOPE* Pressure controller.

Throughout the plant a high degree of automatic control is used, permitting safe and economical operation. Instrumentation includes TRANSAIRE* Transmitters for picking up process variables, TRI-ACT* Controllers, FULSCOPE Controllers and Taylor Recorders of the circular chart type with either one or two TRANSET* automatic-manual setpoint stations inside the case.

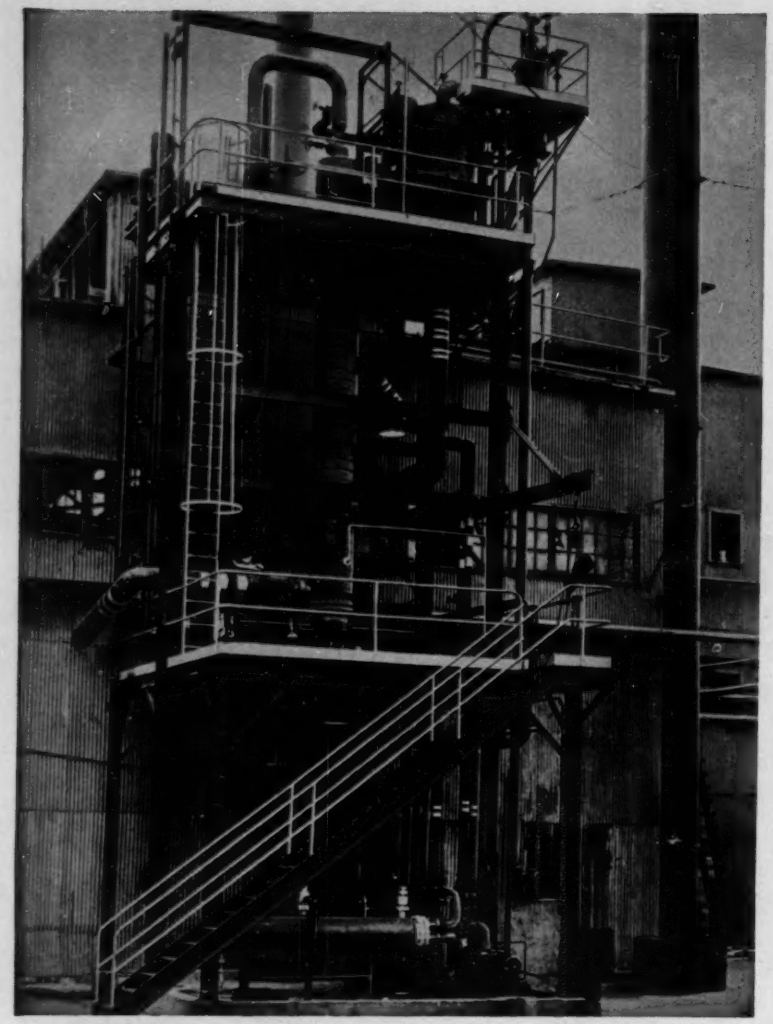
This is the third Hooker Electrochemical Company chlorine-caustic plant utilizing considerable Taylor equipment, and the company seldom has had any operating trouble due to faulty control—striking testimony indeed to the reliability and ruggedness of Taylor Instruments.

Taylor TRANSAIRE Temperature Transmitter measures column temperature and signals controller regulating the addition of steam.

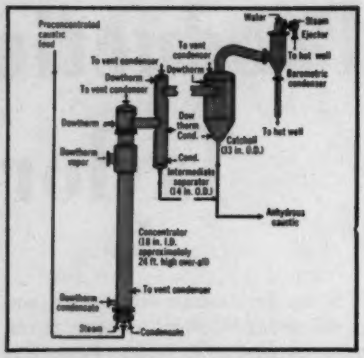


Caustic soda evaporation building. Taylor control panel can be seen in circle at right center.

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

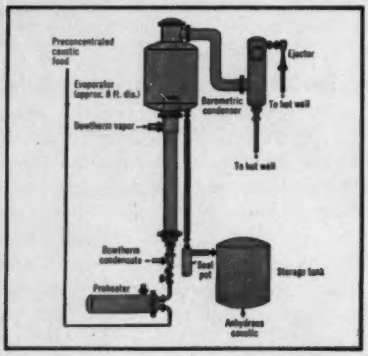


Nine years commercial experience in the continuous finishing of anhydrous caustic soda in this pioneer Swenson Evaporator shows • • •



Schematic drawing of pioneer Swenson Evaporator shown in photograph. Operators say continuous finishing is easy to control automatically and uses only ½ as much fuel as batch finishing.

The information on the continuous caustic finishing unit is published through the courtesy of the Swenson Evaporator Company and Dr. W. L. Badger, originator of the process and designer of the unit.



Schematic drawing of present simplified Swenson Evaporators. In these later units, jacketing is eliminated; thermal insulation prevents freeze-up. Low-carbon nickel tubes, tube sheets, shells and piping keep corrosion low and prevent product contamination.

You don't have to "shade" solid NaOH made in nickel

What's more . . .

- **With good control of chlorate, metal pick-up does not exceed 1 or 2 parts per million.**
- **Original equipment costs only 1/5 as much as a batch-finishing, direct-fired, iron pot installation of equal capacity.**
- **A set of nickel tubes can finish some 17,000 tons of caustic and costs less than 1/2 as much to replace as pots.**

Modern practice is to produce 99.5% solid NaOH continuously in Dowtherm*heated evaporators with contact surfaces of corrosion-resistant nickel. Feed is either 50 or 73% NaOH from which chlorates have been removed by chemical reduction.

"Shading" pots originally installed with the Swenson Evaporator shown, have never been needed. In later installations, caustic is packed directly from the nickel storage tanks without "shading" or final purification.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

For further information on continuous caustic finishing units, write Swenson Evaporator Company, Harvey, Illinois. For assistance with caustic corrosion problems, contact Inco's Corrosion Engineering Section.

*Trademark of the Dow Chemical Company

INCO TRADE MARK **Nickel Alloys**

25%

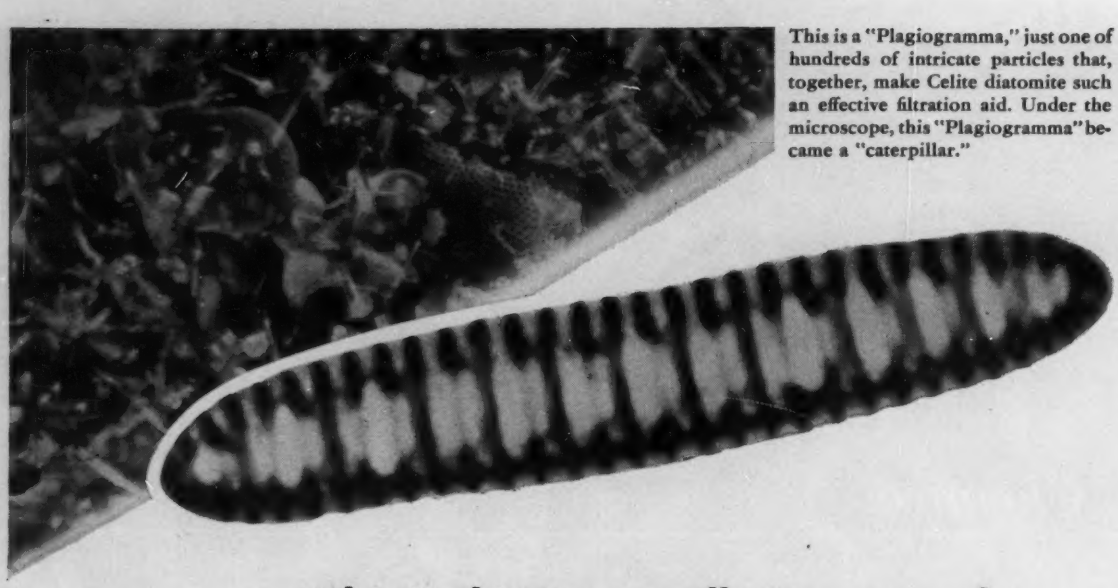
of the world's synthetic ammonia *produced in plants designed by* CHEMICO

Chemico engineered the first synthetic ammonia plants ever to be built in the United States, Mexico, Poland, Egypt, Israel, India, China, the Philippines—even the USSR. In all, forty-nine Chemico-designed ammonia plants are in operation all over the world and the *fiftieth*, for installation in Japan, is presently being designed for Nihon Gas K. K.

With over 41 years of world-wide experience, Chemico continues unceasingly to pioneer improvements on existing chemical processes—Ammonia, Methanol, Nitric Acid, Ammonium Nitrate, Urea, etc.—and to incorporate the latest technical advances in engineering design.

Chemico initiative is exemplified in the new Pensacola Plant of Escambia Bay Chemical Corporation, the first ammonia plant anywhere to use hot potassium carbonate solution for the removal of carbon dioxide from ammonia synthesis gas.

CHEMICAL CONSTRUCTION CORPORATION
A UNIT OF AMERICAN CYANAMID COMPANY
Designers and constructors of complete plants and facilities for the chemical and petrochemical processing industries for over 40 years
525 WEST 43rd STREET, NEW YORK 36, N. Y.
Technical Representatives: Cyanamid Products Ltd., London, South African Cyanamid (Pty.) Ltd., Johannesburg. Cable Address: CHEMICONST, N. Y.



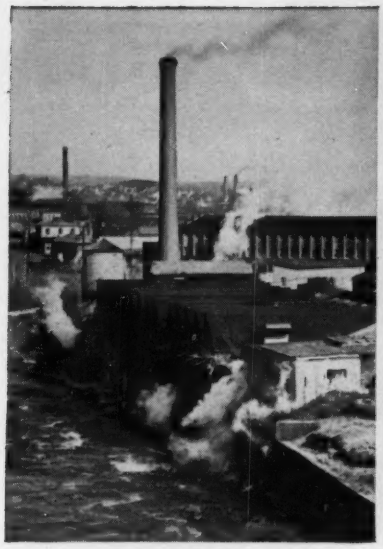
This is a "Plagiogramma," just one of hundreds of intricate particles that, together, make Celite diatomite such an effective filtration aid. Under the microscope, this "Plagiogramma" became a "caterpillar."

What's this "caterpillar" got to do with lower filtration costs?

It's a particle of CELITE that covers more

Assures highest purity in pharmaceuticals

Among the many important uses of Celite diatomite filter aids in industry today is the vital part they play in the production of life-saving antibiotics. Not only does Celite safeguard the purity of aureomycin, streptomycin and other pharmaceuticals; they also provide substantial cost savings that permit wider usage of these *wonder drugs.*



Protects communities from contaminated plant waste

Celite helps control pollution through removal of suspended solids from plant waste waters. Celite treatment often permits plants to reuse this water.

Provides greater clarity in varnish, lacquer and shellac

Celite filtration provides the high degree of clarity required in clear finishes. Celite is also widely used by the paint industry as a flatting agent and pigment extender.

Gives appetizing sparkle to syrups, jellies and other foods

Many food processors make an important *sales plus* of the outstanding brilliance that Celite provides. Celite also helps increase juice yields as a pressing aid.

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filter surface per pound

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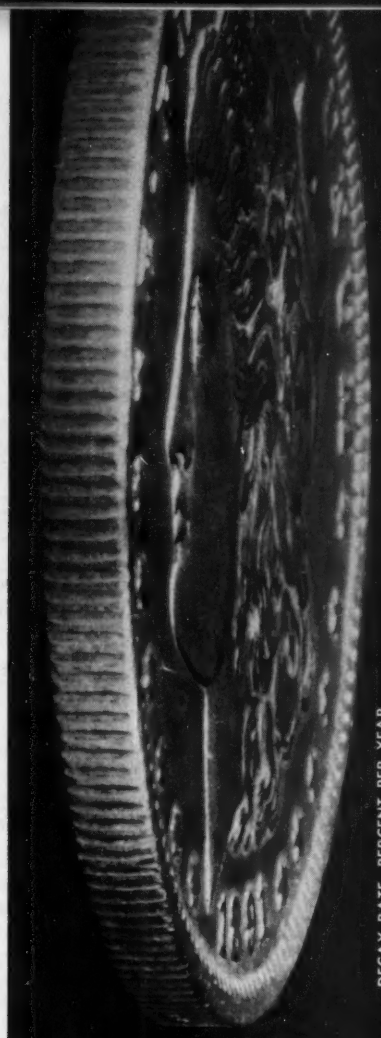
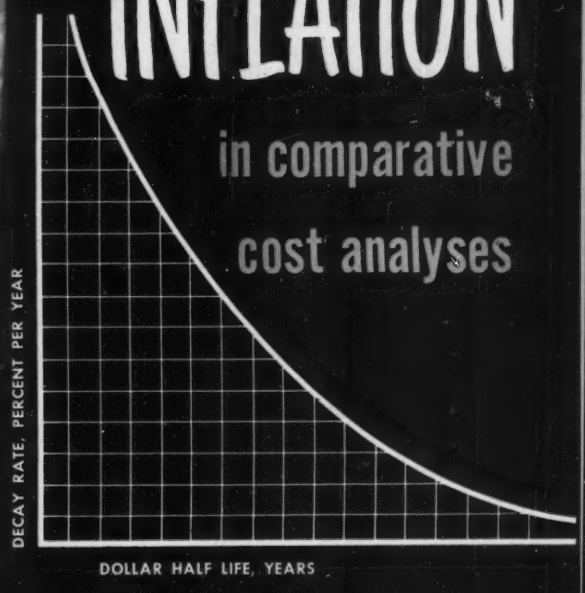


consider INFLATION in comparative cost analyses



BY F. C. JELEN

INFLATION, like the rhinoceros, is an ugly thing; but it exists. In a thermonuclear age engineers must recognize the half life of the dollar.

Decay of the monetary unit from year to year influences the comparative costs of different materials and methods. We can ignore this no more than we can ignore interest—the time value of money. Purpose of this article is to develop exact mathematical relationships so that comparison of alternatives can be made on a sound economic basis that includes the effect of inflation as well as of interest.

The effect of inflation generally favors the article with the longer life. Anticipating a calculation that follows, we find that if steel heat exchanger tubes cost $10,000 and last one year, we can afford to pay $72,470 for tubes that last ten years, money being worth 8% per year.

However, if in addition the dollar decays at a rate of 4% per year, we could afford to pay $84,860 for tubes that last ten years. For mathematical purposes inflation means simply that the monetary standard of comparison is not fixed from year to year but varies by the factor $(1 + d)$ from year to year, where d is the decay rate of the dollar expressed as a decimal.

We do not intend to estimate here the future decay rate of the dollar, but merely intend to show how to include it in cost comparisons. Steele[3] has discussed the inflation rate since 1939 and indicated that in terms of a 100-cent 1939 consumers' dollar, the consumers'

"Indeed, when inflation is a factor, a cost is not completely defined without identifying the time. Capitalized cost refers everything to the present."

dollar in 1951 was worth 56 cents. In this 12-year period, then, an item priced at 56¢ in 1939 would have cost 100¢ in 1951. This corresponds to an inflation rate of about 5% per year.

$$(56)\ (1 + 0.05)^{12} = 100 \text{ (Approx.)}$$

The table on p. 167 will help in choosing a value for d. Thus, if we believe that the dollar declines to half its value in 17.7 years, we should use 4% for the decay rate per year. Prices then will increase by the factor 1.04 every year.

In this article we shall use 4% per year for the inflation rate, but only for the purpose of illustration, without implying that we believe the future inflation rate will be 4% per year.

Use Capitalized Cost

In earlier articles[1, 2] we used capitalized cost to compare alternatives, but inflation was not considered. Now we shall extend the equations to include d, the yearly decay rate.

The term *capitalized cost* is used to designate the first cost plus the present value of an indefinite number of renewals, or more broadly, the present cost on a perpetual basis. However, we do not imply that the item will be perpetuated. Forever is merely a common denominator by which all service lives can be compared on a common basis.

The capitalized cost of an item remains the same whether at the end of its calculated life it is replaced in kind, replaced by something else, or even not replaced at all.

In engineering problems practically all costs fall into four categories. They are:

- Initial cost.
- Fixed annual cost.
- Salvage value.
- Deferred costs.

We will discuss each of these costs in order.

Initial Cost

Suppose an article costs C, that it lasts m years, and that money is worth i per year expressed as a decimal. Consider first the case where the dollar does not decay.

The cost of the first unit is C, and the present value is also C. The cost of the first replacement will likewise be C, but will be incurred m years hence. The present value is

$$C/(1 + i)^m$$

Similarly the present value of the next replacement is

$$C/(1 + i)^{2m}$$

The capitalized cost, K, is given by

$$K = C \sum_{a=0}^{a=\infty} \frac{1}{(1 + i)^{am}}$$

The Σ part of the equation is an infinite geometric series and it reduces to

$$K = CF_{m,i} \qquad (1)$$

where $F_{m,\ i}$ is equal to $(1 + i)^m$ divided by $[(1 + i)^m - 1]$.

Let us now consider the case where the dollar decays d per year expressed as a decimal. The cost of the first unit is C and the present value is also C, as before. The first replacement will cost $C\ (1 + d)^m$ and the present value is

$$C(1 + d)^m/(1 + i)^m$$

Similarly the present value of the next replacement is

$$C(1 + d)^{2m}/(1 + i)^{2m}$$

The capitalized cost is given by

$$K_d = C \sum_{a=0}^{a=\infty} \left(\frac{1 + d}{1 + i}\right)^{am}$$

where K_d denotes capitalized cost with decay rate included. The Σ part is an infinite geometric series and the above reduces to

$$K_d = C \frac{I_{m,\ i}}{I_{m,\ i} - I_{m,\ d}} \qquad (2)$$

where i is larger than d; and where

$$I_{m,\ i} = (1 + i)^m$$
$$I_{d,\ i} = (1 + d)^m$$

If $d = 0$, that is no inflation, $I_{m,\ d}$ equals 1.0 and Eq. (2) reduces to Eq. (1).

Note that Eq. (2) and all equations for K_d derived in this article are valid only for $i > d$. This is not a serious limitation because in calculations of this type this condition is usually met. At least now.

However, a future article will show how to make the comparisons when d is larger than i.

When making calculations of capitalized cost it is convenient to have tables of two factors, the G and I factors, where

$$G_{m,\ i} = \frac{1}{(1 + i)^m - 1}$$
$$I_{m,\ i} = (1 + i)^m$$

A third factor, the F factor, need not be tabulated since it is simply related to the corresponding G factor:

$$F_{m,\ i} = 1 + G_{m,\ i}$$

The table on p. 168 contains a few selected G and I factors for convenience in checking the numerical examples of this article. An extensive tabulation of the factors was given in a previous article (*Chem. Eng.*, Feb. 1954, p. 199). And in a second article we presented a nomograph for estimating these factors (*Chem. Eng.* Aug. 1955, p. 181).

We'll work out two examples to show how the factors are used in capitalized cost calculations.

Problem—Steel heat exchanger tubes cost $10,000 and last one year. Money is worth 8% per year. How much can be spent for tubes that last 10 years (a) if there is no decay of the dollar and (b) if the dollar decays 4% per year?

Solution—By using Eq. (1) we can get K for the one-year tubes.

$$K = CF_{1,\ 8\%} = (10{,}000)\ (13.50)$$
$$K = \$135{,}000$$

Using the same K for ten-year tubes.

$$135{,}000 = CF_{10,\ 8\%} = C(1.8629)$$
$$C = \$72{,}470$$

To answer part (b) we will use Eq. (2). K_d for the one-year tubes is

$$K_d = C \frac{I_{1,\ 8\%}}{I_{1,\ 8\%} - I_{1,\ 4\%}}$$
$$= \frac{10{,}000(1.0800)}{1.0800 - 1.0400}$$
$$K_d = \$270{,}000$$

With the same K_d for the ten-year tubes

$$270{,}000 = C\,\frac{I_{10,\,8\%}}{I_{10,\,8\%} - I_{10,\,4\%}}$$

$$= \frac{C(2.1589)}{2.1589 - 1.4802}$$

$$C = \$84{,}860$$

Problem—A company can choose an ordinary catalyst that costs $10,000 and lasts two years or a special catalyst that costs $63,000 and lasts 15 years. Money is worth 8% per year. What is the minimum decay rate of the dollar that will justify choosing the special catalyst?

Solution—Try $d = 4\%$. By Eq. (2), K_d for the two-year catalyst is

$$K_d = C\,\frac{I_{2,\,8\%}}{I_{2,\,8\%} - I_{2,\,4\%}}$$

$$= 10{,}000\,\frac{1.1664}{1.1664 - 1.0816}$$

$$K_d = \$137{,}550$$

and for the special catalyst,

$$K_d = C\,\frac{I_{15,\,8\%}}{I_{15,\,8\%} - I_{15,\,4\%}}$$

$$= 63{,}000\,\frac{3.1722}{3.1722 - 1.8009}$$

$$K_d = \$145{,}740$$

We find that K_d for the 15-year catalyst is higher. Therefore, $d = 4\%$ is not enough. Try $d = 6\%$. Then, K_d for the two-year catalyst is

$$K_d = C\,\frac{I_{2,\,8\%}}{I_{2,\,8\%} - I_{2,\,6\%}}$$

$$= 10{,}000\,\frac{1.1664}{1.1664 - 1.1236}$$

$$K_d = \$272{,}520$$

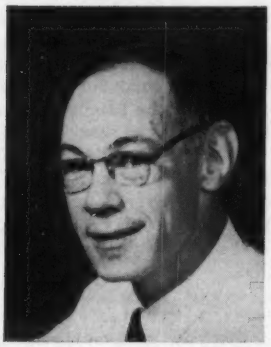
and for the special catalyst,

$$K_d = C\,\frac{I_{15,\,8\%}}{I_{15,\,8\%} - I_{15,\,6\%}}$$

$$= 63{,}000\,\frac{3.1722}{3.1722 - 2.3966}$$

$$K_d = \$257{,}670$$

K_d for the 15-year catalyst is the lower. By interpolation the capitalized costs become equal at about $d = 5\%$. Hence 5% is the minimum decay rate of the dollar that will justify choosing the special catalyst.



FREDERIC C. JELEN presented the concept of capitalized cost and its use in replacement analyses in two earlier articles. We are pleased to present here the extension of these concepts to situations where inflation decays the value of the dollar. Dr. Jelen is a corrosion engineer with Solvay Process Div., Allied Chemical & Dye Corp., Syracuse, N. Y. A graduate of M.I.T. and Harvard, he is a licensed professional engineer in New York State.

Fixed Annual Cost

When there is no inflation the capitalized cost of a fixed annual expense, M, is

$$K = M F_{1,\,i} \qquad (3)$$

With a decay rate, d, the capitalized cost becomes

$$K_d = M\,\frac{1+i}{i-d} \qquad (4)$$

where $i > d$

In Eq. (4) the annual expense, M, which would be a constant if there were no inflation, now increases by the factor $(1 + d)$ each year. But the equation allows for this.

In the strictest sense the yearly expense no longer remains constant and we mean only that it is constant except for the effect of inflation. M is numerically the first-year expense only.

Salvage Value

If an article lasts m years and has a salvage value L, the capitalized cost of the salvage value without inflation is

$$K = -L\,G_{m,\,i} \qquad (5)$$

With a decay rate d the capitalized cost becomes

$$K_d = -L\,\frac{I_{m,\,d}}{I_{m,\,i} - I_{m,\,d}} \qquad (6)$$

where again $i > d$

In Eq. (6) L is what the salvage value would be in today's dollar. Actually, the first salvage value will be $L\,(1 + i)^m$ when it is realized. But Eq. (6) corrects for this.

Indeed, when inflation is a factor, a cost is not completely specified without identifying the time. It is the spirit of capitalized cost to refer everything to the present.

Half Life of the Dollar

Half Life of the Dollar, Years	Decay of the Dollar, % per Year
35.0	2
23.4	3
17.7	4
14.2	5
11.9	6
9.0	8
7.3	10
6.1	12
5.3	14
4.7	16
4.2	18
3.8	20

Deferred Costs

The capitalized cost of an expense B_j occurring during the j-th year for an article lasting m years but without including inflation is

$$K = \frac{B_j F_{m,\,i}}{I_{(j-1),\,i}} \qquad (7)$$

With a decay rate d the capitalized cost becomes

$$K_d = B_j I_{(j-1),\,d}\,\frac{I_{(m-j+1),\,i}}{I_{m,\,i} - I_{m,\,d}} \qquad (8)$$

where $i > d$

Of course, B_j is the cost in today's dollar.

Eq. (8) can be used for a single year or term for all the years. Therefore, it will accommodate all deferred costs however irregular they may be.

A special case of deferred costs is the cost of periodic overhauls. If an article that lasts m years receives an overhaul that costs H (present-dollar basis) every p years and first starting at the end of p years, the capitalized cost without and with inflation is given by

$$K = HG_{p,\,i} \qquad (9)$$

$$K_d = H\,\frac{I_{p,\,d}}{I_{p,\,i} - I_{p,\,d}} \qquad (10)$$

where $i > d$

If H represents an overhaul cost, a certain violation of Eqs. (9) and (10) will occur in practice because the expiration of an article usually

Selected Values of G and I Factors

$$G_{m,i} = 1/[(1+i)^m - 1]$$

$$I_{m,i} = (1+i)^m \qquad F_{m,i} = 1 + G_{m,i}$$

m	$I_{m,4\%}$	$I_{m,6\%}$	$I_{m,8\%}$	$G_{m,4\%}$	$G_{m,6\%}$	$G_{m,8\%}$
1	1.0400	1.0600	1.0800	25.00	16.67	12.50
2	1.0816	1.1236	1.1664	12.25	8.091	6.010
3	1.1249	1.1910	1.2597	8.006	5.235	3.851
4	1.1699	1.2625	1.3605	5.887	3.810	2.774
5	1.2167	1.3382	1.4693	4.616	2.957	2.131
10	1.4802	1.7908	2.1589	2.082	1.264	0.8629
15	1.8009	2.3966	3.1722	1.249	0.716	0.4604

coincides with the time when an overhaul would have been necessary. This overhaul will not be made and its cost H (present price) will be recovered as a salvage value.

Therefore, in practice the following equations are more realistic:

$$K = H(G_{p,i} - G_{m,i}) \qquad (11)$$

$$K_d = H\left(\frac{I_{p,d}}{I_{p,i} - I_{p,d}} - \frac{I_{m,d}}{I_{m,i} - I_{m,d}}\right) \qquad (12)$$

where $i > d$

An Extensive Example

The example that follows demonstrates how various costs can be treated in one problem.

Problem—A heat exchanger uses steel tubes which cost \$10,000 and last four years with \$2,000 salvage value. Cost for cleaning the inside of the tubes is \$3,000/yr. Every two years the outside of the tubes must be cleaned at a cost of \$4,000. During the fourth year there is an extra maintenance expense of \$1,500.

A proposal has been made to substitute alloyed tubes that cost \$95,000, last ten years with \$20,000 salvage value. Maintenance for the alloyed tubes is \$1,000/yr. and savings from increased production are \$6,000/yr., or a net of −\$5,000 per year.

All the above costs are in terms of the present value of the dollar. Money is worth 8% per year. Does it pay to install the alloy tubes if there is no inflation? Reconsider the proposal with an inflation rate of 4% per year.

Solution—When there is no inflation, the capitalized cost of the steel tubes is found by using Eqs. (1), (5), (3), (11) and (7), in that order.

$$CF_{4,8\%} = (10{,}000)(3.774) = 37{,}740$$
$$-LG_{4,8\%} = -(2{,}000)(2.774) = -5{,}548$$
$$MF_{1,8\%} = (3{,}000)(13.5) = 40{,}500$$
$$H(G_{2,8\%} - G_{4,8\%}) = (4{,}000)(6{,}010 - 2{,}774) = 12{,}944$$
$$(B_4/I_{2,8\%})(F_{4,8\%}) = (1{,}500/1.2597)(3.774) = 4{,}494$$
$$K = \$90{,}130$$

We find the capitalized cost of the alloy tubes by using Eqs. (1), (5) and (3), respectively.

$$CF_{10,8\%} = 176{,}976$$
$$-LG_{10,8\%} = -17{,}258$$
$$MF_{1,8\%} = -67{,}500$$
$$K = \$92{,}218$$

Capitalized cost of the steel tubes is \$90,130 against \$92,218 for the alloy tubes. Therefore, it will not pay to substitute alloy tubes when the interest rate is 8% per year and the inflation rate is 0% per year.

When the inflation rate is 4% per year (and the interest rate is 8% per year) the capitalized cost of the steel tubes is found by using Eqs. (2), (6), (4), (12) and (8), respectively.

$$CI_{4,8\%}/(I_{4,8\%} - I_{4,4\%}) = 10{,}000\,\frac{1.3605}{1.3605 - 1.1699} = 71{,}380$$

$$-LI_{4,4\%}/(I_{4,8\%} - I_{4,4\%}) = -2{,}000\,\frac{1.1699}{1.3605 - 1.1699} = -12{,}276$$

$$M(1+i)/(i-d) = 3{,}000\,\frac{1.08}{0.08 - 0.04} = 81{,}000$$

$$H\left(\frac{I_{2,4\%}}{I_{2,8\%} - I_{2,4\%}} - \frac{I_{4,4\%}}{I_{4,8\%} - I_{4,4\%}}\right) = 4{,}000\left(\frac{1.0816}{1.1664 - 1.0816} - \frac{1.1699}{1.3605 - 1.1699}\right) = 26{,}468$$

$$B_4 I_{2,4\%}\,\frac{I_{1,8\%}}{I_{4,8\%} - I_{4,4\%}} = \frac{(1{,}500)(1.1249)(1.08)}{1.3605 - 1.1699} = 9{,}561$$

$$K_d = \$176{,}133$$

The capitalized cost of the alloy tubes is found by using Eqs. (2), (6) and (4) respectively.

$$C\,\frac{I_{10,8\%}}{I_{10,8\%} - I_{10,4\%}} = 302{,}190$$

$$-L\,\frac{I_{10,4\%}}{I_{10,8\%} - I_{10,4\%}} = -43{,}619$$

$$M(1+i)/(i-d) = -135{,}000$$

$$K_d = \$123{,}571$$

Now the capitalized cost of the alloy tubes, \$123,571, is less than that for the steel tubes, \$176,133. Therefore, when the inflation rate is 4% per year, it will pay to install the alloy tubes.

Equivalent Yearly Burden

In our previous articles we pointed out that if K is the capitalized cost without inflation, then

$$k = iK \qquad (13)$$

where k is the equivalent uniform end-of-year yearly cost. To grasp the significance of this, consider the following example.

Problem—Suppose an item costs \$10,000, lasts three years, and that money is worth 8% per year. Then,

$$K = CF_{3,8\%} = (10{,}000)(4.851)$$
$$K = 48{,}510$$
$$k = iK = (0.08)(48{,}510$$
$$k = \$3{,}881$$

We show now that \$3,881 paid at the end of the year for three years will repay for the \$10,000 first cost.

The first payment of \$3,881 at the end of the first year will draw interest for two years, the next payment for one year and the third payment will draw no interest. At the end of three years we will have \$12,597.

$$(3{,}881)(1.08)^2 = 4{,}525$$
$$(3{,}881)(1.08)^1 = 4{,}191$$
$$(3{,}881)(1.08)^0 = 3{,}881$$
$$\$12{,}597$$

The original \$10,000 is also worth \$12,597 at the end of three years.

$$(10{,}000)(1.08)^3 = \$12{,}597$$

Therefore, the uniform end-of-year annual payments of \$3,881 will exactly repay the original \$10,000.

We have emphasized that although capitalized cost is based on all costs for an indefinite time, comparisons made from it are correct for limited times. The example

above should make this evident. The item has been paid for by the equivalent uniform end-of-year annual cost which was derived from the capitalized cost. And at the end of three years it matters not whether the item is replaced in kind, replaced by something else, or even not replaced at all.

Let's consider now what happens when inflation is included.

Problem—An item costs \$10,000, lasts three years, money is worth 8% per year and the dollar decays 4% per year. Then,

$$K_d = C \frac{I_{m,\,i}}{I_{m,\,i} - I_{m,\,d}}$$

$$= 10{,}000 \frac{1.2597}{1.2597 - 1.1249}$$

$$K_d = \$93{,}415$$

Now consider that

$$k_d = (i - d)\ K_d$$

which for this example becomes:

$$k_d = (0.08 - 0.04)\ (93{,}415)$$
$$k_d = \$3{,}737 \rightarrow$$

We show next that k_d is an end-of-year cost, but that it increases by the factor $(1 + d)$ each year. We place an arrow alongside the \$3,737 to emphasize that it increases by the factor $(1 + d)$ each year.

The first payment of \$3,737 at the end of the first year will draw interest for two years. The second payment of (\$3,737) $(1 + d)$ draws interest for one year. The third payment of (\$3,737) $(1 + d)^2$ draws no interest. At the end of three years we will have \$12,597.

Nomenclature

B_j	Cost during the j-th year, present dollars
C	Initial cost of a facility, dollars
d	Inflation rate, decimal per year
$F_{m,\,i}$	$1+G_{m,\,i}$
$G_{m,\,i}$	$1/[(1 + i)^m - 1]$
H	Periodic deferred cost, present dollars
i	Interest rate, decimal per year
$I_{m,\,i}$	$(1 + i)^m$
j	Year in which cost B_j occurs
k	Equivalent yearly cost, without inflation
k_d	Equivalent yearly burden, with inflation
K	Capitalized cost, without inflation
K_d	Capitalized cost, with inflation
L	Salvage value, present dollars
m	Useful life of a facility, years
M	Fixed annual burden (or without inflation, annual expense) present dollars per year
p	Period over which H is deferred, years

$$(3{,}737)\ (1.08)^2 = 4{,}359$$
$$(3{,}737)\ (1.04)\ (1.08)^1 = 4{,}196$$
$$(3{,}737)\ (1.04)^2\ (1.08)^0 = 4{,}042$$
$$\$12{,}597$$

At the end of three years the \$10,000 representing the original cost would amount to \$12,597.

$$(10{,}000)\ (1.08)^3 = \$12{,}597$$

Thus, our end of the year cost of \$3,737 $\longrightarrow$ will pay for the first article. It will also pay for the next replacement as the following analogous calculation shows:

$$3{,}737(1.04)^3\ (1.08)^2 = 4{,}903$$
$$3{,}737(1.04)^4\ (1.08)^1 = 4{,}720$$
$$3{,}737(1.04)^5\ (1.08)^0 = 4{,}547$$
$$\$14{,}170$$

At the end of three years,

$$10{,}000(1 + d)^3$$

representing the cost of the replacement would also amount to \$14,170.

$$10{,}000(1.04)^3\ (1.08)^3 = \$14{,}170$$

From this example we see that the end-of-year annual cost is not only a yearly cost but it is independent of how many replacements are made, if any. It is the yearly cost whether we replace in kind, replace by something else, or do not replace at all.

If we had tried to calculate an equivalent uniform end-of-year annual cost in a problem where inflation had been a factor, we would have encountered an enigma. We would have found that a uniform yearly cost would depend upon how many replacements we have in mind. The uniform yearly cost would not be definite.

Equivalent yearly costs both with and without inflation can be encompassed together by introducing the principle of "uniform yearly burden." By this we mean that the yearly cost should represent a uniform yearly burden, and not necessarily a uniform yearly cost in dollars. Only when there is no inflation is a uniform yearly burden a uniform yearly cost.

With inflation a uniform yearly burden is a yearly cost which increases by the factor $(1 + d)$ each year. Thus, in the following equation

$$k_d = (i - d)\ K_d \qquad (14)$$

we will call k_d the equivalent uniform end-of-year yearly burden, or loosely the equivalent yearly burden.

Eq. (14) permits us to shift from capitalized cost with inflation to equivalent yearly burden. The case with no inflation is merely a special case where d is equal to zero.

We demonstrated above that Eq. (14) is valid for initial costs. It is also valid for any K_d, singly or in combinations, whatever types of costs enter the calculation of K_d.

Either K_d or k_d can be used for expressing cost comparisons. If two systems are compared the system having the lower K_d will necessarily have the lower k_d.

In this article we have extended the capitalized cost method to include the effect of inflation on comparative cost analyses. When the inflation rate is zero, all the new equations reduce to the equations that we presented in earlier articles where inflation was not considered.

We have introduced the new concept of equivalent yearly burden. The old concept of equivalent *uniform* yearly cost applies only when inflation is absent and breaks down when inflation is a factor. The equivalent yearly burden is derived directly from the capitalized cost. It is a more extensive concept than equivalent *uniform* yearly cost and reduces to the latter when there is no inflation.

The equations for capitalized cost with inflation that are given in this article are to be used only when the interest rate is greater than the inflation rate. An article scheduled for an early issue will show how to make cost comparisons when the inflation rate is equal to or greater than the interest rate.

Next Month

Runaway Inflation

Once it gets started, inflation has a way of getting worse. Then what happens to your comparative cost analyses? Next month author Jelen shows you how to proceed when interest rates lag the decaying dollar.

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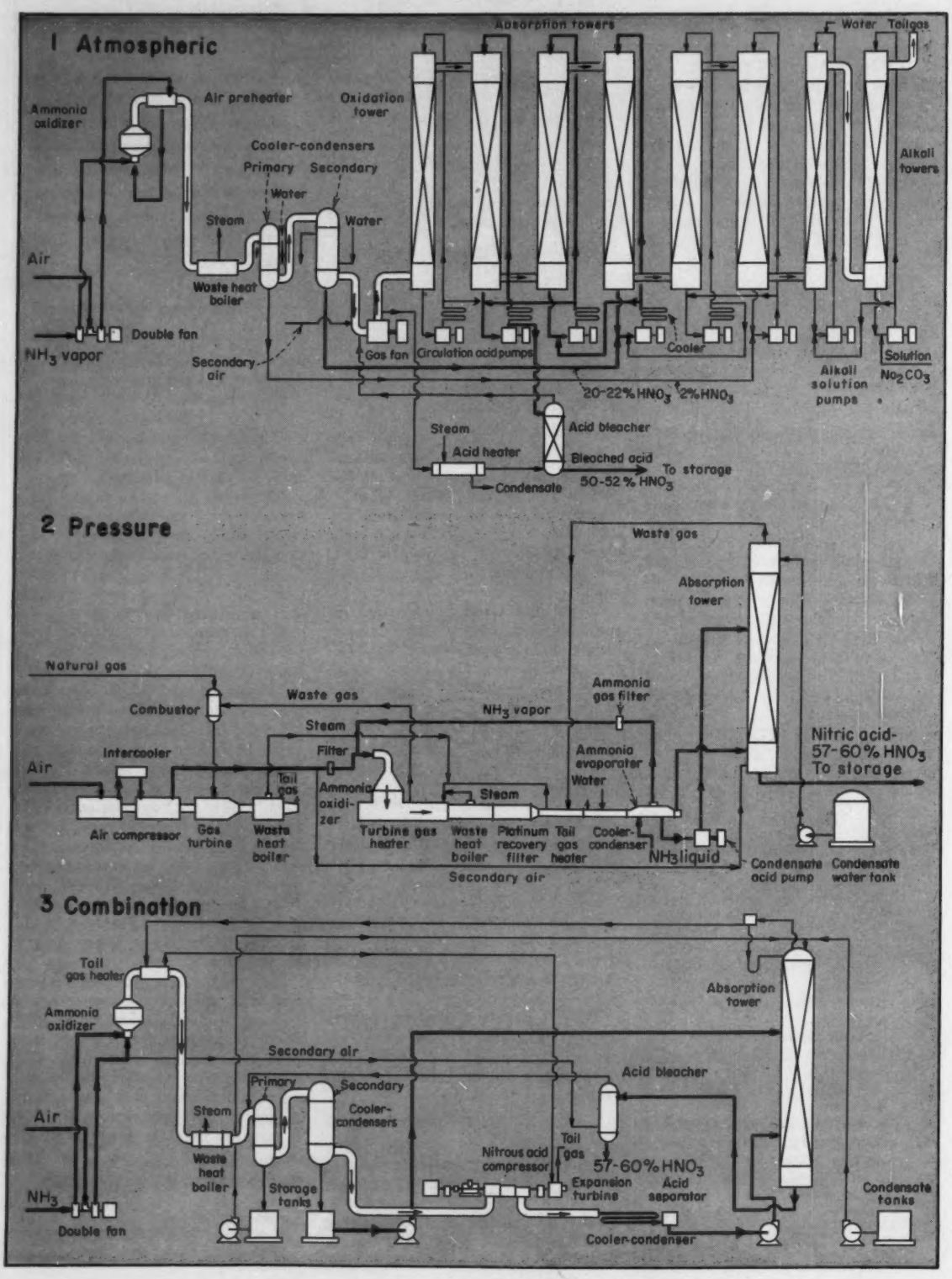
Today's Commercial HNO_3 Processes: A



Critical Comparison

By S. STRELZOFF, Chemical Construction Corp.

An Expert Reports on . . .

- √ Advantages & disadvantages
- √ Capital investment comparisons of processes
- √ Operating costs for each process
- √ How they work (atm., pressure, combination)

TREMENDOUS demands of agriculture and explosives since World War I have been a big factor in establishing nitric acid second to sulfuric as an industrial barometer. But no less important has been the development of cheap, modern methods for making nitric. For one thing, the synthesis of ammonia from atmospheric nitrogen and generated hydrogen has cut nitric free from dependence on sulfuric acid.

Today most nitric acid is produced by oxidation of ammonia with oxygen from the air.

There are two distinct steps in this process: first, ammonia oxidation:

$$4NH_3 + 5O_2 = 4NO + 6H_2O + 216{,}700 \text{ cal.} \quad (a)$$

This reaction takes place in the presence of a catalyst—usually a platinum alloy.

Oxidation of nitric oxide to nitrous oxide and absorption of nitrous oxide in water to form nitric acid:

$$2NO + O_2 = 2NO_2 + 26{,}902 \text{ cal.} \quad (b)$$

$$3NO_2 + H_2O = 2HNO_3 + NO + 32{,}530 \text{ cal.} \quad (c)$$

The NO formed is reoxidized to NO_2 and subsequently converted to HNO_3 in the same manner as the NO_2 formed by reaction (b).

Summerizing, the over-all reaction taking place in the process can be represented by the equation:

$$NH_3 + 2O_2 = HNO_3 + H_2O + 100{,}600 \text{ cal.} \quad (d)$$

Unfortunately, a certain amount of the combined nitrogen entering the process is lost through unavoidable side reactions.

During the oxidation step, some of the ammonia is lost by direct degradation into elementary nitrogen:

$$4NH_3 + 3O_2 = 2N_2 + 6H_2O + 303{,}100 \text{ cal.} \quad (e)$$

It is also possible that some of the ammonia is decomposed directly:

$$2NH_3 = N_2 + 3H_2 - 21{,}960 \text{ cal.} \quad (f)$$

In most modern plants, however, the total conversion yield from ammonia to nitric acid is better than 93%.

Most industrial plants in Europe and in the United States use a platinum-rhodium alloy as a catalyst instead of pure platinum because of its higher mechanical resistance at high temperatures (1,380-1,650 F.). The catalyst is employed in the form of a wire gauze of about 80 mesh. The number of layers of gauze used varies from plant to plant depending on the process employed. For an oxidation unit operating at atmospheric pressure, two to three layers are sufficient. For operation at higher pressures, however, the number of layers may reach 16 to 20.

Three Process Schemes for 60%

Various schemes are used for ammonia oxidation and the absorption of the resulting nitric oxides:

1. Oxidation of ammonia to nitric oxide, and conversion to nitric acid by absorption, both steps being carried out at atmospheric pressure.
2. Oxidation and absorption steps both carried out at pressures higher than atmospheric.
3. Ammonia oxidation at atmospheric pressure followed by compression and the absorption of the nitric oxides at pressures higher than atmospheric.

The selection of the appropriate scheme depends on the relative importance given to:

- The cost of the installation.
- Operating costs, which are a function of the price of ammonia, utilities, catalyst, labor.

In general, it is found that scheme 2, in which the ammonia oxidation and absorption steps are both carried out under a pressure of from 60 to 110 psig, leads to the lowest investment. This is the type of plant generally found in the United States.

In Western Europe, however, scheme 3 is used in preference to any other. It involves ammonia oxidation at atmospheric pressure and absorption at a pressure of at least 30 psig. This is mainly because great importance is given to platinum catalyst loss, which is considerably higher when the ammonia oxidation is carried out under pressure.

1. Ammonia oxidation and conversion to nitric acid of the resultant nitric oxides—both carried out at pressures close to atmospheric.

Liquid ammonia is evaporated either indirectly by a refrigerating medium, by a salt solution, or by the water which is used to cool the nitric acid circulating in the absorption system, or directly by the warm nitric acid which is in circulation over the absorption towers. The ammonia gas is collected in a gas-holder. From the gas-holder it is pumped by a fan to a mixer where filtered air is added. The resultant mixture of ammonia and air, usually containing from 9.5% to 11% ammonia, is again filtered before reaching the catalyst. In order to maintain the proper temperature (1,380-1,470 F.), the air is preheated to about 300-390 F. by heat exchange with out-coming nitrous oxides.

After leaving the burner, the nitrous gases pass through the air preheater, and then go to a waste heat boiler where the gas temperature is reduced to about 355-390 F. The gas is further cooled in a series of cooler-condensers in which nitric acid begins to form. At this point, it is desirable to separate as much as possible of the water which

forms according to reactions (a) and (e).

It is important that this water should contain the smallest possible amount of nitric acid (2-3% HNO_3). The subsequent cooler-condenser will then produce an acid containing approximately 20-22% HNO_3. The condensates formed during this step are conveyed to the absorption section of the plant.

Nitrous gases, leaving the last cooler-condenser at a temperature approaching that of the cooling water, pass through a series of absorption towers where they are scrubbed by weak acid solutions in counter-current flow. Make-up water and the weak condensate from the first cooler-condenser are added to the last absorption tower.

The stronger condensate is introduced into the system at an appropriate point where the acid strength of the condensate is close to that of the acid in cirulation. Circulation of the acid is handled by centrifugal pumps. Before reaching the top of the towers, the acid is cooled by water-cooled heat exchangers. In most cases, the acid in the first towers is cooled directly by the evaporation of liquid ammonia. Final product (45-52% HNO_3) is drawn-off from the second absorption tower. The first tower is usually needed to complete the pre-oxidation of the nitric oxides according to reaction (b).

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Need More Towers

A low tail gas O_2 and low absorption efficiencies call for large numbers of towers to reduce the nitric oxide content of the tail gas to the accepted figure of approximately 0.2 to 0.3% NO. Also, for most absorption systems operating at atmospheric pressure, it's customary to add towers for scrubbing with solutions of sodium or calcium carbonate or sodium or calcium hydroxide.

These nitrite-nitrate solutions of sodium or calcium are treated with nitric acid to convert all the salts into nitrates. The nitric oxides resulting from this treatment are recovered in the absorption system.

The additional cost of the equipment and the necessity of treating relatively large quantities of salt solutions, which must be evaporated and crystallized in the form of marketable by-products, add considerably to the ultimate production cost of the nitric acid.

Most of the larger nitric acid plants, where considerable amounts of nitrates are produced, do have adequate facilities for disposing of the nitrogen solutions. Nevertheless, it should be pointed out that in the U. S. the marketing of sodium or calcium nitrate is becoming more and more difficult due to the tremendous upsurge in the production of more profitable ammonium nitrate.

We are, therefore, witnessing the complete disappearance of this atmospheric scheme in the U. S. and its replacement by the process in which both ammonia oxidation and the absorption of nitric oxides are carried out under pressure.

In Western Europe, however, some new atmospheric plants are still being built. These plants incorporate process improvements made possible by the elimination of the air preheater. By increasing the ammonia content of the air-ammonia mixture up to 12%, a sufficiently high temperature is attained. In this case, the burner is followed directly by the waste heat boiler, and is often made integral with it.

Additional improvements have been made in the design of the boiler, which is followed by an economizer, where feed water is preheated before being introduced into the boiler. This new type of installation has made it possible to increase the steam production from 0.7 to 1.1 tons/day of 100% HNO_3. The steam produced can be delivered at a pressure varying from 150 to 350 psig., depending on plant requirements.

Operating Data

In general, for atmospheric type schemes, the following operating figures are sufficiently representative. Figures are given per ton 100% HNO_3 (as 45-52% acid):

Anhydrous ammonia	0.29-0.30 tons
Platinum loss	less than 0.002 troy oz.
Power	85-90 kwh.
Steam credit	0.6-1.0 tons at 150 psig.
Cooling water	27,000 U. S. gal.

Yields are approximately as follows:

Conversion of ammonia to nitric acid: 90-92%. Conversion of ammonia to alkali salts: 3-4%. Total conversion of ammonia to nitric acid plus nitrates: 93-96%.

The volume of the necessary absorption system is approximately 1,000 cu. ft. per ton of HNO_3 per 24 hours. About 25% of this volume is required for the alkali scrubbers. A typical flow diagram for atmospheric type plants is given. Compare this absorption system volume with 20 cu. ft. for a pressure of 110 psig.

While most of the plants which operate throughout at atmospheric pressure use platinum or platinum-rhodium catalysts, there are plants which use catalysts made of non-precious metals. Oxides of iron, manganese, molybdenum and particularly cobalt are still used in some such plants. It is also important to note that in some nitric acid plants, where by-product oxygen is available at zero cost, its use instead of atmospheric oxygen makes it possible to reduce considerably the absorption volume required per daily ton of HNO_3 and this, therefore, contributes to lowering the cost of production.

When operating at atmospheric pressure, the capacity per burner, for mechanical reasons, is limited

by the allowable diameter of the platinum gauze, which usually does not exceed 6½ ft. The daily production rate of a burner of this size will not exceed 25 short tons of 100% HNO_3, even under the most favorable conditions.

New Design Concept

In the early days, absorption towers were built of acid-proof materials such as granite, stoneware, or concrete lined with acid-proof brick. In the mid-twenties the introduction of stainless steel eased considerably the design, construction and maintenance problems involved.

The use of stainless steel has now changed the whole conception of the manufacture of nitric acid by making it possible to fabricate the equipment necessary for operation under pressure. Since this revolution, which took place in the mid-twenties, most new plants, both in Europe and in the U. S., have adopted process schemes in which either the absorption step or both oxidation and absorption are designed to operate under pressure.

It is interesting to note that in Europe most new type installations are based on oxidation at atmospheric pressure, followed by compression and absorption of the nitrous oxides at a pressure of about 30 psig.

2. Ammonia oxidation and conversion of the resultant nitric oxides both carried out at greater than atmospheric pressure.

For the last twenty years, practically all new installations in the U. S. have been designed for ammonia oxidation under pressure followed by absorption under practically the same pressure conditions. An American type installation generally begins with the following steps:

- Ammonia Evaporation
- Air Compression
- Mixing of Air and Ammonia
- Oxidation in a burner equipped with a platinum or platinum-rhodium catalyst.

The burner is followed by a series of heat exchangers. These are designed primarily to reduce the temperature of the nitrous gases (close to the temperature of the cooling water) prior to admission of the gases into the absorption system. If air is compressed by a non-centrifugal compressor, these heat exchangers also:

a. Preheat air

b. Preheat tail gas if power recovery is employed

c. Produce steam

d. Condense, in the form of weak acid, most of the water formed in the oxidation reactions

In case air is furnished by a centrifugal compressor, there is no need for air preheating since the air is delivered by such compressors at a temperature of 450-500 F.—sufficiently high for satisfactory performance of the ammonia oxidizer.

What It Takes to Make a Ton of 100% HNO_3

	Ammonia (Tons)	Platinum (Troy Oz.)	Power (Kwh.)	Steam Credit (Tons)	Cooling Water (Gal.)	Acid Strength (% HNO_3)
1	0.290–0.300	0.0025	85–90	1.0	27,000	45–52
2	0.290–0.294	0.005–0.01	350*	0.8–1.25	30,000	57–60
3	0.287–0.290	0.0025	350*	1.0	30,000	57–60

* This figure varies depending on power recovery. A new Florida plant uses 16 kwh.

Operating Data

The attached flow diagram illustrates the process scheme for a plant operating under pressure.

Generally speaking, the process steps are as follows:

Liquid ammonia is evaporated either directly by the heats of formation of nitrous gases or nitric acid or, indirectly, by steam generated from the recovery of the heats of reaction.

Air is compressed by a compressor to a pressure which varies somewhat from plant to plant but in the most recent plants, is about 110 psig. For large capacity units, this compressor is generally of the centrifugal type.

The streams of filtered ammonia gas and air mix at a ratio of about 10.5% NH_3 and the mixture then goes to the burner. Air, delivered by centrifugal compressors, is sufficiently hot (450-500 F.) but, if reciprocal type compressors are used, the air is preheated by heat exchange with out-coming nitrous gases. In both cases, the temperature of the air before being mixed with ammonia must be approximately 500 F. In the burner itself, the temperature at the catalyst is maintained at about 900 C. (1,650 F.).

If power recovery is adopted, the gas leaving the burner passes through a heat exchanger to bring the tail gas up to a temperature as high as 950 F. The burner gas is then cooled in a waste heat boiler in which steam is generated at a pressure of from 150 to 225 psig. A catalyst recovery filter is usually installed at the cold end of the boiler. Finally, the gas is cooled in a cooler-condenser in which most of the water produced by the oxidation reactions is removed as 40-45% HNO_3 acid.

The gas then flows into the absorption system where the oxidation of NO to NO_2 is completed and these oxides are absorbed in water to form nitric acid.

Weak acid from the condenser is introduced at an appropriate point in the absorption system. The absorption system proper may consist either of one bubble-cap tray tower or of a cascade of absorption drums, each equipped with one tray and coolers. In the bubble-cap tray tower the coolers are placed directly on the trays around the bubble-caps.

The product acid is bleached in the lower section of the absorption tower itself or in a separate bleacher. The acid produced (57-60% HNO_3) does not contain more than 0.05% HNO_2.

The over-all efficiency of absorption under pressure is sufficiently high (98-99%) to permit the elimination of alkali scrubbers.

Advantages of Pressure

Recently, it has been found possible to reduce the residual nitric oxide in the tail gas to one part per million. This has been accomplished in conjunction with improved devices for power recovery. The flow diagram shows a process scheme

(2) incorporating total power recovery.

In the power recovery scheme, the steam generated in the waste heat boilers mixes with the tail gas and the mixture brought up to the proper temperature with natural gas, or other fuel. The hot gaseous stream is then expanded in a gas turbine which drives the compressor. In this way, a complete power balance may be achieved, eliminating any requirement for additional steam or for additional electric power for air compression.

The one great advantage of all pressure schemes, as compared with operation at atmospheric pressure, lies in the significant reduction of the equipment volume required for oxidation, heat exchange and, above all, for absorption. For a system operating at an initial pressure of 110 psig and an exit pressure of 85 psig, the required absorption volume will be about 17 cu. ft. per daily ton of HNO_3 as compared to 1,000 cu. ft. for the case of an atmospheric pressure unit. It is understandable, therefore, that the investment cost for a pressure installation is considerably lower, in spite of the use of expensive compressors.

Complete power recovery contributes to lower operating costs. It compares very favorably also from the standpoint of compactness. One burner with a diameter of approximately 4 ft. can produce 250 tons of HNO_3 per day. Such a burner is followed by a single set of heat exchangers for heat recovery and a single absorption tower.

A comparable plant of the atmospheric type would require 10 burners and, depending on their dimensions, from 30 to 60 absorption towers. The greatly increased number of fans, circulating pumps, etc., and the increased amount of piping and other auxiliary facilities would add considerably to the task of the maintenance operators.

The only advantage which proponents of atmospheric-type units can invoke in their favor lies in lower platinum consumption. However, with improved designs for platinum filters, this handicap is bound to gradually disappear.

In favor of the atmospheric-type burner is the fact that it has a higher conversion efficiency from ammonia to nitric oxide. This efficiency is 97-98% as compared with 95-96% for pressure burners. However, the latest type of pressure burner, in which the diameter has been increased to reduce the mass velocity of the gas, has shown definite promise and it is likely that this type of burner will soon also show efficiencies of 98% or even better.

In this respect, it is interesting to note that some European designers have recently abandoned atmospheric-type burners and have switched to complete pressure systems. This trend is particularly significant in view of the great experience of these designers with the combination type plant.

3. Atmospheric oxidation combined with absorption under pressure.

In this type of plant, the nitrous gases leaving the atmospheric oxidizer pass through heat exchangers where they are cooled to a temperature close to that of the cooling water. A turbo-compressor, of all stainless steel construction, compresses gases to a pressure which may vary from 30 psig to 105 psig according to the type of plant.

Since these nitrous gases contain an excess of air, this compression helps considerably in completing the oxidation of NO to NO_2 and N_2O_4. The compressor is followed by a condenser from which 55-62% HNO_3 acid separates out. The product acid is conveyed directly to the bleacher. The remaining nitrous gases are absorbed either in a series of packed towers over which acid circulates (by centrifugal pumps) or by a cascade of absorption drums or in a bubble-cap tray tower. In the last two cases acid flows by gravity in a direction counter-current to the gas flow. In packed towers the acid flows alternately counter-current and co-current to the gas flow.

The acid which is condensed out prior to compression is added at the appropriate points in the absorption system. In order to recover the power consumed for air compression, the tail gas leaving the absorption system is preheated by heat exchange with the hot nitrous gases leaving the burner, before being released to the atmosphere by an expander mounted on the shaft of the gas compressor.

This combined scheme claims the advantages of higher ammonia oxidation yield and lower platinum loss, added to higher absorption efficiency.

Comparison of Processes

A process comparison must proceed on the basis of:

1. Investment cost & amortization charges
2. Operating requirements
3. Maintenance requirements
4. Flexibility of operation

The table indicates a slight advantage for the combined scheme over the complete pressure scheme.

A comparison of investment costs can be expressed with sufficient accuracy by the following ratios:

Atmospheric	1.0
Complete pressure	0.89
Combined	1.11

The combined scheme is relatively higher than the complete pressure scheme in investment cost since it requires a more expensive compressor and a greater number of burners and heat exchangers.

Power Consumption

The following ratio is given without taking power recovery into account:

Atmospheric	1.0
Complete pressure	7.2
Combined	5.3

However, remember that if power recovery is adopted, the power requirements for both the complete pressure scheme and the combined scheme may well be less than for the simple atmospheric system.

Stainless Steel Requirements

The ratio for the three processes is as follows for stainless steel requirements:

Atmospheric	1.0
Complete pressure	0.54
Combined	0.75

In conclusion, there are of course several more or less intangible factors which must be taken into consideration. Over-all operation is more simple for the atmospheric scheme. In addition, the centrifugal compressors used in the complete and combined pressure schemes do require more skilled supervision. In regard to control instrumentation, the combined system is somewhat more elaborate than the complete pressure scheme.

Liquid Proportioning

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Role of Liquid Proportioning

Accurate metering and feeding are mandatory as process industries go to continuous operation.

Feeding of ingredients to process operations is no longer in the "horse and buggy" stage—as quantities can no longer be suitably measured by pails and bags, or scoops and droppers. In fact, accurate metering and feeding of liquids and solids is almost mandatory as the process industries tend more and more toward continuous operation.

An important consideration in any continuous process layout is the accurate, proportional and dependable feeding of the various ingredients. Forms in which the materials are fed will vary from bone dry through the slurry stage to liquids and even, in some cases, the gaseous state.

In this article we will be concerned only with those devices used in the feeding of liquids. T. R. Olive has covered the feeding of solids in his report "Solids Feeders," *Chem. Eng.*, Nov. 1952.

The classification "liquid feeder" covers a considerable proportion of those materials that would ordinarily be encountered in a continuous process operation. For our term liquid, in this case, refers to that group of materials which range from a true solution to a slurry or dispersion of solids in a liquid. The slurry may require a mechanical agitation to maintain the suspension, or it may have such a high ratio of solids to liquid that it can almost be classed as a solid.

We encounter other liquid characteristics which add to the problem of selecting the proper feeding and metering equipment. These include vapor pressure (volatility), viscosity, density, temperature, corrosiveness and toxicity.

The necessity for minimizing handling of materials must be taken into account. In this connection, metering and feeding of liquids can be combined in one operation—or they can be handled separately and tied together by some form of closed loop or feedback cycle.

However, it is difficult to feed and meter certain liquids simultaneously. And providing a material state to facilitate combined feeding and metering often increases the handling required, as does separating the feeding and metering stages.

A basic concept of the continuous flow process is to minimize handling of materials. The ideal plant is one in which the raw material goes directly into process without intermediate handling or working, and comes out the other end of the plant as finished product.

To approach this, the material must be handled in a state as near that of the raw material as possible. Achievement of this by feeding devices alone is fairly simple. But when we try to meter the same material, we find that our real problem is at hand.

Important as the minimum handling consideration is in continuous processing, the predominant factors are most often accuracy and timing of feed of the various ingredients that go to make up the final product. These factors will govern our discussion concerning the various types of liquid feeding devices available and how they may be combined.

In its strictest sense, as defined by Webster's dictionary, proportioning is the relating of one portion to another, or to the whole, or of one thing to another, as respects magnitude, quantity or degree.

Applied to a chemical compounding process, it relates to the continuous uniform feeding, and/or metering of the materials that go to make up a blend in the proper ratio—so that any increment at any instant will contain exactly the proper ratio of all components.

The problem then is to establish these ratio requirements, determine the form in which the material is to be fed, and select the equipment which will feed and meter the ingredients within the tolerable accuracy limits.

Batch vs. Continuous

The time-proved method by which apportioning is done is through the use of batch tanks or kettles. This is strictly an intermittent process—although given enough tankage, feeding and metering can be done continuously. Of course, this necessitates a valving arrangement to divert material streams from tank to tank.

Metering of materials to the kettle is carried out in a variety of ways. For instance, the operator fills to levels or uses meters with cut-offs to measure the individual ingredients. Or he can preweigh or preload the required quantities and, at the proper moment in his cycle, discharge from intermediate storage to the tank.

There is also the possibility of metering pumps and solids feeders automatically controlled as to cycle duration, either energized in sequence or controlled by the operator.

Any or all of these methods can be applied to a continuous proportioning system, which makes the conversion from a batch to continuous system not too great a capital investment.

Disadvantages connected with the batch system are numerous. For one thing, there is considerable lost time in tying up a tank which serves no purpose except as a temporary receptacle. It must be filled, mixed, sampled, unloaded and cleaned. Meanwhile production requirements must be met. Result is lack of tankage to maintain plant output. This means a heavy capital outlay in kettles, and large sections of floor space for tankage alone.

Another factor to consider is the labor involved in the batch method. Much of the metering and quality control must be left to the operator. The human element is always open to error. More often than not doctoring of batches is required—even the "slopping" of the entire kettle contents on occasion.

On the other hand, continuous automatic operation with its closely-controlled reactions between components provides greater uniformity of product, better quality control, and reduction in material losses and rework. More important, it reduces manufacturing costs through elimination of duplication in material handling, costly batch kettles, mixing time and the possibility of human error.

It gives management a means of readily increasing production on an economical basis. Processes in which toxic or explosive chemicals are handled call for automatic means to substitute for manual handling and the resultant hazards.

These are some of the reasons for the swing towards the fully automatic plant. Instrumentation, metering and blending equipment have been developed to the point they can be depended upon to fulfill the requirements—whether the feeds be liquid, solid, or gaseous.

Feeders vs. Meters

Feeding is ordinarily considered as merely the operation of transfer, while metering is referred to as the function of measurement. However, in the field of materials handling, the terms feeder and meter are often used interchangeably.

Generally, a liquid feeder, as referred to for proportioning purposes, is a device which will quantitatively *measure* and *transfer* liquids from one position to another. If this function is carried on by external powering, it is truly described as a feeder. If the fluid under measurement performs the powering operation, it would be classified as a flow regulator.

A liquid meter, on the other hand, will quantitatively *measure* the liquids, and will be powered by the fluid under measurement itself. It performs no transfer operation whatsoever, nor does it exercise any control over itself. In many cases the meter can, by additional equipment, become a flow regulator.

Two modes of measurement are possible. It can be a gravimetric or volumetric depending on the degree of accuracy desired.

Volumetric measurement is susceptible to temperature in the case of liquids—and to specific gravity, viscosity, etc.

Gravimetric measurement, on the other hand, depends on force of gravity and will maintain rate settings independent of changes in material conditions.

Processes requiring extreme accuracy of material proportioning (less than plus or minus 1% by weight) are regulated by a gravimetric feed-meter devices though at a considerably higher capital outlay. Yet good accuracy is obtainable (plus or minus 1% by volume) by volumetric units—provided nearly constant conditions are maintained.

Volumetric Devices—Meters

They are based on area-differential, positive displacement, and velocity measurement.

Considering first those volumetric devices which we can classify as meters, it is found that they are based primarily on principles of area-differential, positive displacement and velocity measurement.

These are all elements in fairly common use today, and are being continually improved. We are just now beginning to apply electrical principles to this measurement function, as represented by the velocity meters.

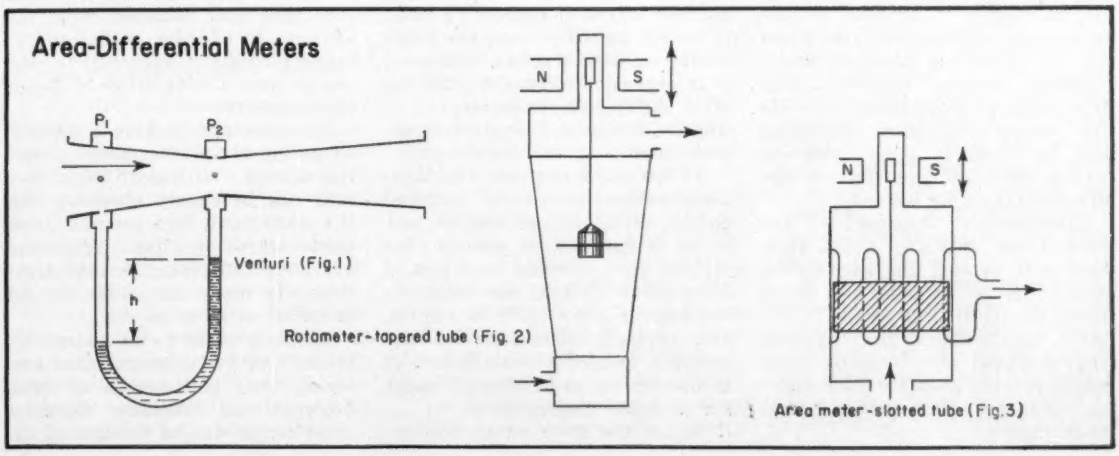
Area-Differential Meters

Area-differential meters are of two types. One uses fixed, cross-sectional area (throat restriction) and measurement of the resulting differential (pressure drop across the restriction) produced with changes of flow (Fig. 1). The other maintains a fixed differential head and permits the cross-sectional area of the restriction to vary as a measurement of flow (Fig. 2).

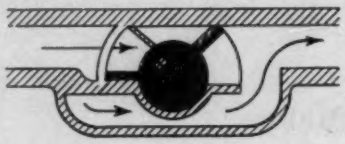
The former may, according to special design characteristics, be a venturi tube, orifice plate, flow nozzle, insert nozzle, or flow tube. Each, however, has the basic elements—restricted throat and indicating element (manometer) for establishing differential head.

The latter is most commonly used in the so-called rotameter design. It consists of a vertically-mounted tapered tube in which a float is free to travel. The area variation used as a measure of flow is the annular space between float and tube wall. Flow is resisted by weight of float, and the float will assume a position to maintain a constant differential. The tapered tube is calibrated so that reading the position of the bob directly indicates flow rate. In the case of the measured differential, a square root function must be extracted for conversion to flow rate.

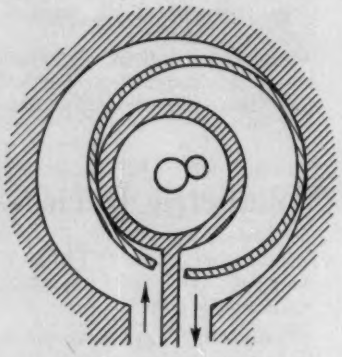
Another type of variable-area meter uses position of a plug with respect to reference position in a slotted tube (Fig. 3). The plug may be spring or weight-loaded to produce the desired differential.



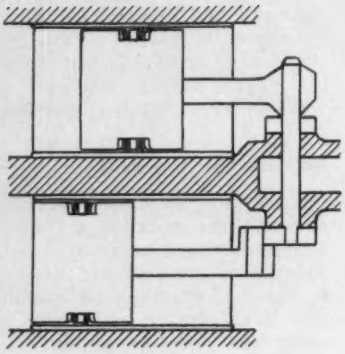
Positive Displacement Meters



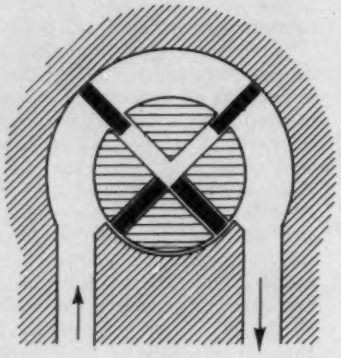
Disk (Fig. 4)



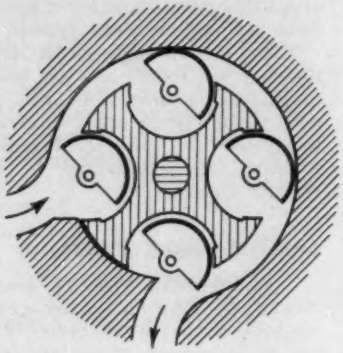
Oscillating piston (Fig. 5)



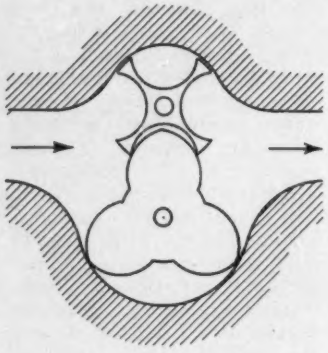
Piston (Fig. 6)



Vane (Fig. 7)



Vane (Fig. 8)



Gear (Fig. 9)

Flow changes result in a movement of the plug upward or downward to attain the desired differential constant. In so doing it produces more or less slot opening. Or, basically, it adjusts to the necessary cross-sectional area opening to maintain a constant head.

Special sensing, conversion and transmitting attachments provide for remote totalizing, indicating and recording of these rates—as well as electrical, pneumatic or hydraulic signals for control.

Considerable information has been made available about this. Suffice it to say, the area-differential type of metering can range from the most inexpensive (thin plate, square-edge orifice) to carefully-designed and installed units which provide good accuracy (plus or minus 1%), low head loss, and wide ranges.

Certain advantages and disadvantages apply to this method of metering. For the variable differential types, the venturi produces the lowest head loss and requires shortest length of approach piping. It is well suited to measure fluids having suspended solids. However, it is expensive compared with the other differential producers. It is lengthy, heavy and requires extensive installation considerations.

At the other extreme, the thin-plate orifice is simply installed and/or replaced, and readily produced in the field. It produces the highest unrecoverable head loss of differential devices, can result in build-up or wear while in service, and requires careful orifice and pressure connection installation. It is also limited as to capacity range for accurate measurement.

One of the more recent developments in this field is the Dall Flow tube which combines many of the advantages of the venturi. Yet it provides short laying length, less weight, and produces even less head loss than that obtained with the venturi. In addition, it has an extremely constant coefficient of discharge over a wide range of Reynolds numbers.

The area meters have a distinct advantage in the transparent metering element. With clear fluids, flow rate can be clearly observed. On the other hand, high pressures and temperature require additional armoring and protective considerations. In many cases this has led to use of an all-metal tube.

All parts of the meter can readily be built of corrosion-resistant material. Any plating out of fluid, however, can introduce measurement errors due to changes of di-

mensions altering calibration. No moving parts are involved which would require packed seals.

Area meters will accurately measure extremely low flows and fluids of high viscosity. They are also well-suited to metering of high-temperature streams requiring jackets. The nearly-linear scale of measurement permits its ready use with other linear measurements—eliminating any need for conversion or matching equipment. Breakage of tubes and wear can be serious maintenance problems. Packing the tubes requires care and skill.

Prior to the advent of the "dry" type variable differential element, mercury normally used in the manometer element and the level transmitting arrangement afforded possible contamination and seal problems. The bellows and diaphragm type transmitting elements have eliminated this problem.

Installed cost of variable area meters will vary with size and capacity. With variable head meters, the differential-sensing device cost will remain constant and only the flow-sensing element cost will vary. As a result, total installed cost for variable-area meters will be lower in the low-capacity range, and will exceed the variable-differential cost at some point in the mid-ranges.

Accuracy can range fairly far afield without careful attention to recommended practices. Normally an accuracy guarantee, as supplied by a manufacturer, is defined as a percent of the total scale of the instrument. This can be misleading, as a rather poor value may result at the lower end of the scale. There are instruments rated for accuracy as a per cent of the instantaneous rate, which will give the potential user a better over-all accuracy.

Positive Displacement Meters

Positive displacement meters are designed as total-quantity measuring devices, whereas in area-differential units the rate of discharge is the basic unit of measurement.

Each has its particular suitability, although either type can be equipped for conversion of measured valves. For instance, area-differential meters (normally indicating and recording) can be furnished for integration. And positive displacement meters (normally totalizing) are easily equipped for indicating.

Principle of operation for the positive displacement meter is temporary isolation of measured volumes. A flowing stream is divided into equal volumetric segments in passing through the meter—and a count is made of each segment. In being broken up into small bites, and in producing a rotary output, some energy is required. This manifests itself as pressure drop. This pressure drop is higher than that found in equivalent area-differential meters. Therefore, the greater accuracy obtainable with this type of meter is at the sacrifice of greater pressure drop.

Many types are available in which a measured volume is trapped, transferred, and discharged. Advantages for any particular one over another would depend to a great extent on the type of liquid, its lubricity, flow, range, pressure conditions, length of operation, desired life, pressure loss, size, weight, complexity and cost. Each of the various types will have some favorable factors based on above conditions, but it is doubtful that any one meter will meet all of these.

The type most commonly encountered is the nutating disk piston or wobble plate meter (Fig. 4). It is inexpensive, simple in construction, and well-suited to metering of water and inert chemicals containing no suspended solids. Hot and corrosive liquids are troublesome because of materials of construction.

The meter itself consists of a chamber containing inlet and outlet ports. A disk or dished plate with a ball at the center revolves about a vertical plate within the chamber. An incoming liquid face causes the disk to wobble as it moves trapping the liquid as the inlet port is closed off, and releasing it as the outlet port uncovers.

As the disk rotates it drives, through a step-down gear mechanism, into an integrator to register total flow for control purposes. An electric contactor can be mounted in the spindle housing to transmit an electric pulse for each revolution. Or a balanced pilot valve can be driven by spindle rotation (suitably converted to reciprocating motion) to alternately feed operating fluid (air, steam, hydraulic) to the drive end of a feeding device.

Another type using the same scheme is the oscillating piston (Fig. 5). This operates much the same as the disk meter. A piston or cylinder oscillates eccentrically about a roller. It is held in close contact with the chamber walls, and actually merely wobbles about. It, too, is held at one point by a vertical plate or diaphragm which also acts as a separator between inlet and outlet. Entering liquid drives the piston around the guide. The liquid is emitted after producing one revolution of the output shaft.

Still a third type of piston meter actually uses pistons in the normal sense. Double or quadruple-acting pistons are driven by the fluid. Piston action controls operation of slide valves for controlling admission and expulsion of fluid, and actuates meter register drive shaft (Fig. 6).

Clearances between moving element and the stationary housing (normally the meter chamber) will determine to a great extent the accuracy obtainable with the positive displacement meter.

An important factor here concerns whether the seal between moving parts is of a capillary type (in which the liquid itself serves as the sealing medium), or whether it is the directly-packed sealed type as represented by the piston meter (in which moving parts actually come in contact to seal off the measured volume).

In the former design, viscosity of the fluid and degree of clearance determine the amount of fluid which will slip by adjoining sliding parts. As viscosity increases, slippage decreases. In the latter, brass liners and leather cups on pistons, as well as rotary face to face valves, effectively seal the fluid so that no slippage results. This, of course, imposes limitations on size, complexity, and friction load.

Another class of positive displacement meter, the vane type, uses evenly-spaced vanes in the periphery of a rotor (Fig. 7). These rotate about a fixed cam as fluid moves through measuring chamber. A roller at the base of each vane rides the cam and follows its contour about the cycle. The vanes are guided radially.

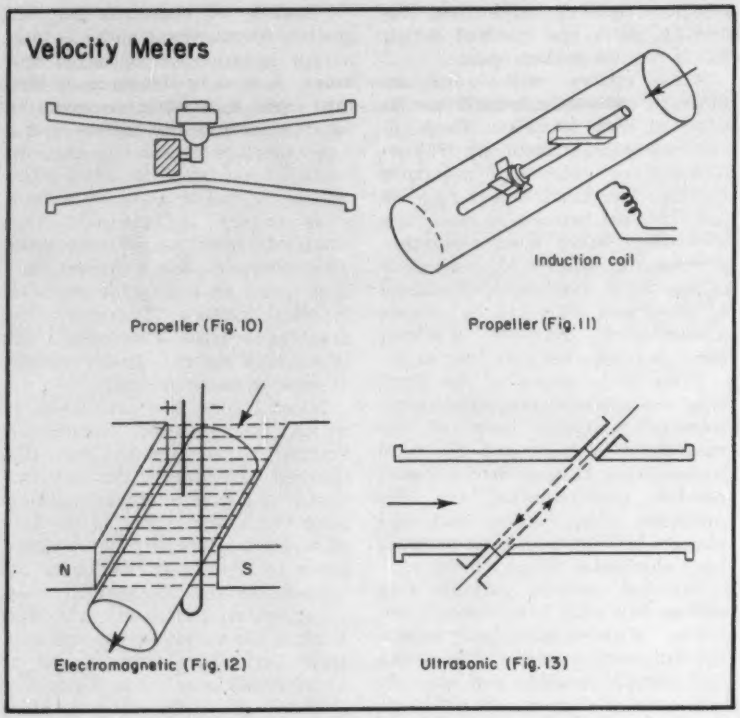
A point in the rotation is reached where two successive vanes are fully extended, thereby forming a filled chamber of precise volume. For each rotor revolution, four of these closed chamber measurements are produced. The action is smooth

and continuous, producing no arresting of liquid velocity.

Still another in the same class has measuring elements consisting of four half-moon shaped vanes equally-spaced about a centrally-mounted rotor (Fig. 8). Since the meter is mounted in the vertical plane (most meters are mounted horizontally), the entering stream impinges on the first vane.

As this stream drives the rotor, it also tends to rotate the vane to seal off a definite volume between itself and the following vane going through the same movements. Continued movement of the rotor causes the vane to revolve and release the fluid to discharge. The vane then passes a close clearance section, which positions it ready to receive the next volume of liquid.

The two-spiral fluted rotor meter, representative of the gear or double rotor type, provides a measuring space between lobes of the rotors (Fig. 9). Close clearances are maintained and sealed by the capillary action of the fluid.



Velocity Meters

Still a third category of volumetric meters is that classified as velocity or current type.

The liquid flow formula, $Q = AV$, provides the basic theory on which is based each of the metering categories discussed. In the variable head meter, area A is fixed and the velocity V is measured as a function of differential head h ($V = K\sqrt{h}$).

Means have been devised to obtain this velocity value directly. To do it, the velocity of a moving stream is used to turn a propeller or turbine, cut lines of magnetic force, or interrupt an ultrasonic beam.

The mechanical units fall into two classes. One is a screw type (Fig. 10) in which a propeller (less than 8/10 of pipe diameter) is concentrically mounted to the longitudinal pipe axis. Speed of rotation, directly proportional to flow, is transmitted through reduction gearing driving into an integrator register. Volumetric accuracies of plus or minus 2% over a 10:1 range are obtainable.

Advantages of this type of unit include (1) simple design and ease of installation for large pipelines, (2) self-contained metering element, and (3) low pressure drop (one manufacturer uses a venturi shape to reduce this loss even more).

Straightening vanes should be incorporated in the approach pipe, to reduce sensitivity to velocity distribution upstream. These meters readily operate for capacities to 150% over rating. Extensive operation at this range does reduce meter life due to increase in bearing wear, but the accuracy curve shows no change.

The second mechanical group is a turbine type. In this, flow from a horizontal line passes upward or downward through a vertically mounted spiral-blade rotor. Clearance between housing and rotor is comparable to that for positive displacement meters. The upflow type has the added advantage of balancing the weight thrust of the impeller, thereby reducing bearing load.

Another type of velocity measuring element again uses a propeller mounted in the stream (Fig. 11). The propeller shaft contains a permanent magnet within a non-magnetic housing. The rotor, spinning at a rate proportional to flow, sets up an AC voltage in a pickup coil mounted outside the pipe. The induced voltage frequency varies directly with rotor speed, and a converter delivers a DC voltage proportional to the established frequency. A potentiometer measure of this DC output will indicate, record and/or control.

To avoid bearing-mounted rotor friction drag and pressure losses, a unique feature is used. A venturi rotor shape establishes upstream thrust components which exceed downstream "drag" factor. This causes the rotor to "float" in position between guide bushings. Temperatures up to 1,200 F. can be handled. Flow characteristics are linear, as in the case of any velocity type meter, and accuracies of plus or minus ½% of full scale are obtainable. Four diameters of straight approach pipe are recommended.

The EMF produced by a conductor cutting magnetic lines of force forms the basis for still another velocity meter (Fig. 12). Flush electrodes are mounted in the pipeline. The pipe itself is surrounded by an AC electromagnet. The principle, of course, states that moving a material containing electrically charged particles through a magnetic field will tend to cause

the charged particles to move away from the magnetic force lines and set up an electric potential difference at right angles to the field and direction of movement.

If the magnetic field is maintained constant, the EMF becomes a linear function of the velocity of the conductor (liquid stream). It can be transmitted for indicator, recorder or control purposes.

Certain problems present themselves, but it appears that careful design and engineering can overcome these. For instance, an AC magnet is used instead of a permanent magnet, because of the tendency of electrodes to develop EMFs of their own. These EMFs do not remain constant, but drift. With the AC magnet, the alternating flow EMF can be separated electrically from the slow drifting galvanic EMF of the electrodes.

But this AC has a troublesome effect. The liquid in the pipe acts as a transformer winding. A current is induced in it, independent of whether the liquid is moving or not. This causes the electrodes to pick up another AC EMF. This, however, is 90 deg. out of phase with the flow EMF, and can be separated from it by a phase-sensitive circuit.

This and other sources of trouble are carefully avoided with suitable precautions to produce an EMF dependent on the velocity of the moving liquid only.

Most recent addition to the velocity class of metering device is that involving the retarding of ultrasonic beams by fluid flow (Fig. 13).

Briefly two beams transmit their energy diagonally across the pipe stream in opposite directions. The pulses of energy from the two loops, integrated and mixed, appear as a beat frequency on the output. These beams are transmitted in bursts, and spaced according to the speed of sound through the liquid being measured.

This unit has found considerable application in jet aircraft for fuel measurement, primarily because of its light weight and all-electrical operation. Accuracy is given as 2% of full scale for a 20:1 range.

Volumetric Devices—Feeders

They range from fairly-crude affairs to finely-machined, precision feeding equipment.

Moving now to the category of volumetric devices which can be classified as feeders or flow regulators, we find a range from fairly crude affairs to finely-machined, precision equipment.

Inferential Feeders

Before the advent of specially-designed units for handling liquid addition, the individual ingenuity of plant operators come into play in devising necessary "gadgets" to measure quantities into a process tank or stream.

Basically, these all amount to use of the principles on which meters are based. In essence, the two variables in the flow formula $Q = AV$ are used: cross-sectional area across which pressure changes are measured or developed, and upstream and downstream pressures producing fixed or variable differentials.

If we maintain a level in a tank by means of a float valve, vary the restriction in the outlet line, and maintain the outlet pressure conditions—we perform a reverse action to that of the area-differential metering device previously discussed. Variations in the restriction will produce predictable flow rates. Downstream discharge to atmosphere removes controls necessary on this end.

The so-called "piano box" feeder follows this principle. Here a tank with float control valve to maintain liquid level discharges to atmosphere. It contains plugged holes diagonally down one side. Starting from the bottom, by removing one, two, three, etc. plugs, the approximate desired rate will result. We have maintained upstream and downstream conditions across our restriction, and can easily vary its size by unplugging or plugging holes.

In another scheme (Fig. 14) the orifice and downstream head are held constant, and differential is varied by moving a wier or overflow device to increase or decrease the head on the upstream side of the orifice.

Another uses the variable area-fixed differential meter principle as in Fig. 3, and provides a control to adjust an additional orifice for rate adjustment.

All of these are inferential devices in which flow rates are inferred from maintenance of other conditions (area and differential). As such they are susceptible to errors due to build-up on restrictions, discrepancies in level due to inaccuracies of level-setting devices, temperature, viscosity, etc. Except for the last illustration, all are devices applicable only to atmospheric or low-head feeding arrangements.

Paddle Wheel Feeders

Another simple yet effective volumetric liquid feeder is the paddle wheel or rotary bucket type (Fig. 15). Again, a head tank with level-control float valve furnishes the supply system. However, instead of an inferential system, a metering wheel very much like an impulse turbine wheel provides continuous volumetric measurement. The rotary dipper wheel can be driven at variable speed for rate adjustment. It transfers the liquid over a baffle and into the discharge section for gravity feed.

In this unit as well as in the other constant-head types, simplicity is the key factor. Few moving parts lend designs of this type to special coatings or materials for corrosion resistance.

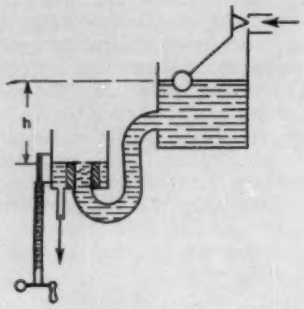
Pot Feeders

Another simple and early device to feed liquids is the "pot" type (Fig. 16).

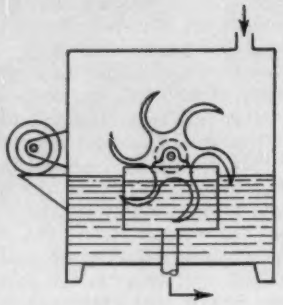
Lump or brick chemicals, slow to dissolve or of a constant solubility, are preloaded into the pot. Pressure taps from the pot to an orifice plate or similar differential producer will provide a high pressure on the upstream side and a lower pressure on the downstream side—due to throttling effect of the orifice. Resulting main line flow through the pot will carry chemical in solution to the main line in proportion to flow.

The flow control valve can, in turn, be used to regulate flow to the pot so that all settings will be

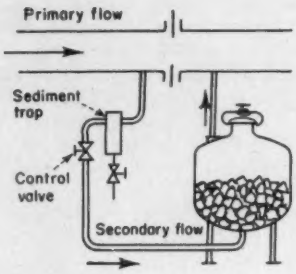
Volumetric Feeders



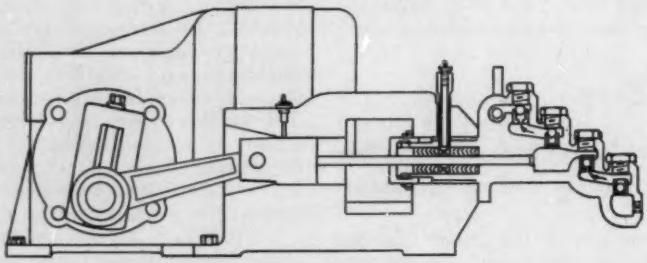
Head tank (Fig. 14)



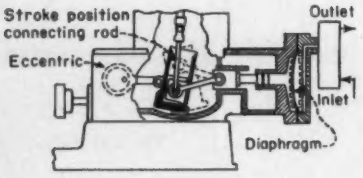
Paddle wheel (Fig. 15)



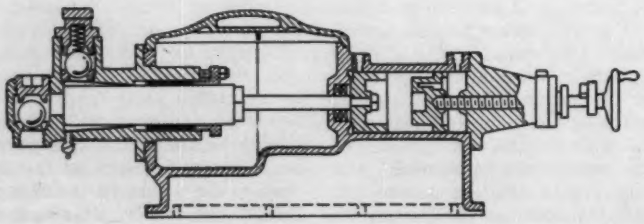
Pot feeder (Fig. 16)



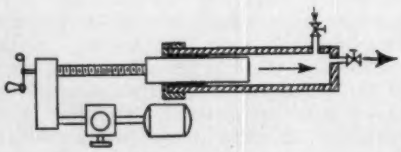
Positive displacement plunger pump (Fig. 17)



Positive displacement diaphragm pump (Fig. 18)



Fluid driven pump (Fig. 19)



Syringe (Fig. 20)

some reproducible fraction of the flow through the orifice. It will remain that way even if main line flow varies. This provides a ratio control of secondary chemical to main line flow.

However, the method is not too accurate. Chemicals of constant solubility are not very prevalent, feed rate cannot be too high or excessive size of feeder is required, channeling of the chemical bed can occur, and corrosion or build-up on the orifice or regulating valve will introduce errors in the differential produced.

Positive Displacement Feeders

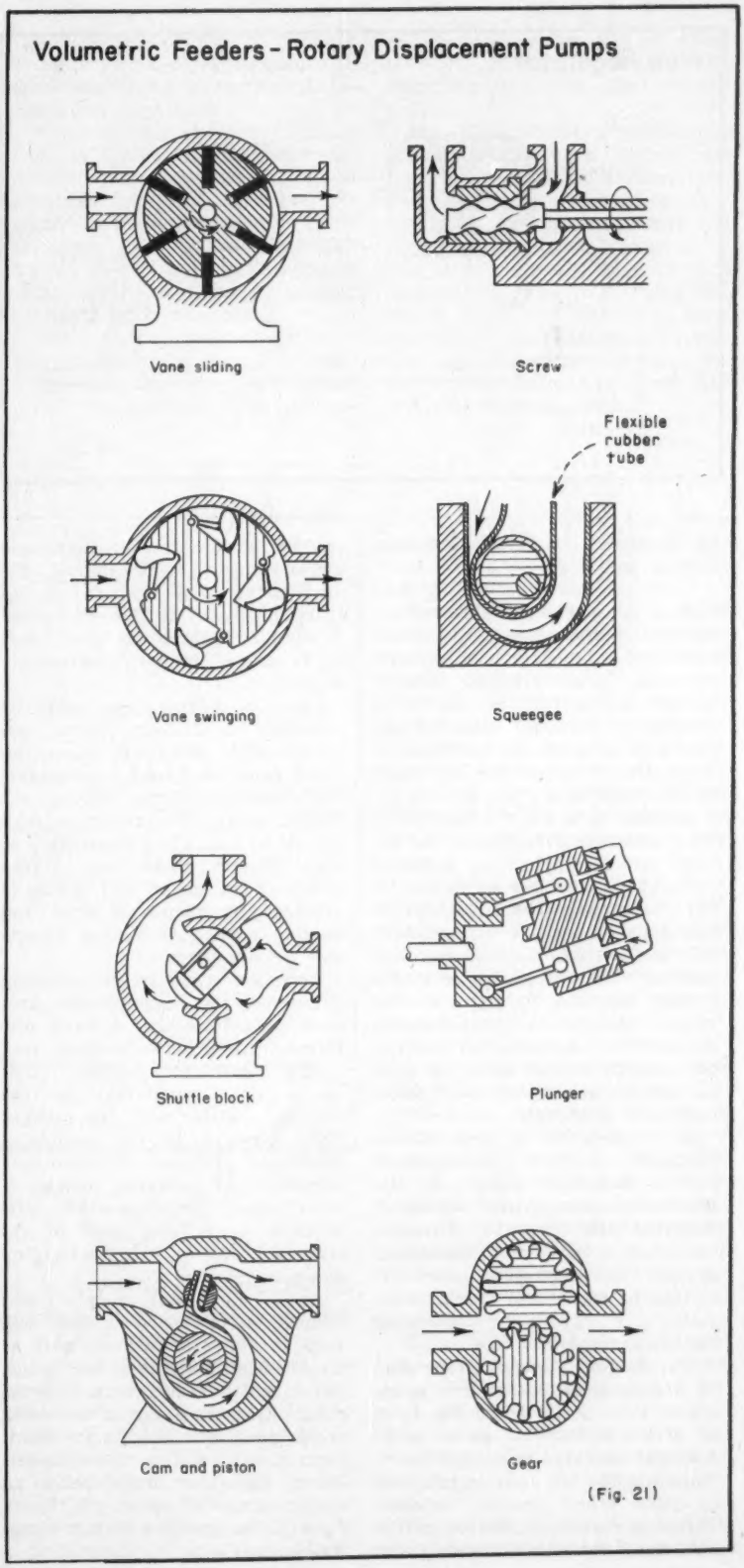
Probably the most dependable of liquid volumetric feeding devices is the positive displacement plunger pump. It finds it greatest use in the feeding of small quantities. This takes care of discharge pressure conditions of any magnitude. Capacities are available from a fraction of a cc. per minute to 50 gpm.

The pump itself consists of a motor driven through an integral gear head or separate speed reducer (Fig. 17). This shaft normally operates a crank. A crank arm—through the crosshead—produces recriprocating movement of the reagent plunger.

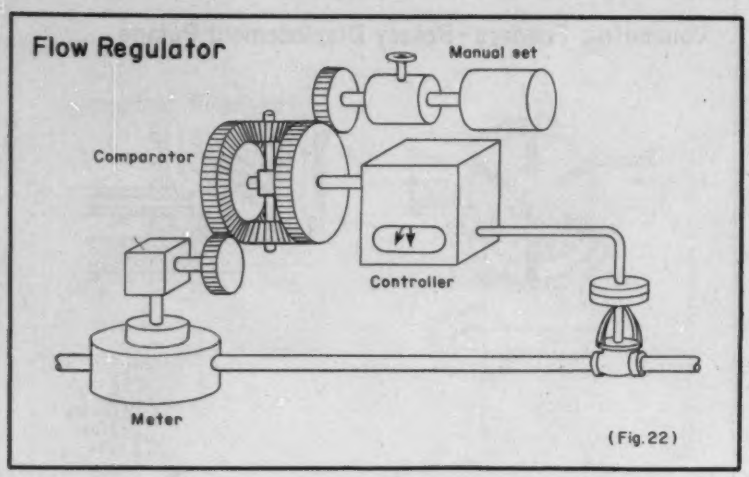
A threaded-crank allows manual adjustment of the crank arm from zero to maximum throw, which in turn will provide stroke-length variations of the plunger—producing a delivery range from zero to maximum capacity. The crosshead guide is calibrated to indicate this setting. Normally these pumps are guaranteed within plus or minus 1% accuracy for a 10:1 delivery range.

In the reagent cylinder, as a precision-ground plunger is withdrawn the preset stroke length through a stuffing box, a metered volume of solution is drawn through the suction line. With plunger motion reversed, the suction valve closes (valves are normally of the ball type) and the volume is forced through the discharge check valve to the point of application.

Since the pump is of the reciprocating type, a pulsating flow will occur. This effect can be reduced or almost eliminated by use of two or even three pumps mounted on a common base-plate, with discharge strokes exactly out of step. Hydrau-



(Fig. 21)



(Fig. 22)

lic dampers or surge chambers may be used.

Units of this type can be furnished in special metals, rubber, plastic or ceramic—thereby making them suitable for handling any chemical. Either stroking rate or stroke length can be controlled remotely—producing capacity adjustment according to variation in flow, pH, viscosity or any other process condition.

Instead of a solid plunger, the fluid motivating force can be applied by a diaphragm, actuated either by a plunger or hydraulic fluid (Fig. 18). The advantage in this type of positive displacement unit is the elimination of chemical packing. The diaphragm acts as a gasket, too, and tightly seals the reagent cylinder. The diaphragms are normally neoprene or rubber, but recently special materials such as plastics and metal alloys have been used effectively.

A modification of the motor-operated positive displacement pumps described above is the pneumatic or hydraulic-powered metering pump (Fig. 19). This can be either a positive displacement plunger or diaphragm unit—but instead of motor and crank, pneumatic or hydraulic powering furnishes the drive.

The reagent plunger is operated by direct connection to this pneumatic or hydraulic drive. The drive is actuated from a pilot valve, normally operated in proportion to main line flow but often in response to some other process variable. Piston movement is limited by the position of the adjustable stop, and can be set for zero to maximum stroke length by means of the micrometer threaded shaft running from the piston to the handwheel. A counter geared to this shaft reads stroke length in increments of 0.01 in.

Capacity settings are made by reference to delivery curve furnished with each unit. Since delivery is represented by a straight-line function, stroke setting for desired output can easily be read and set by handwheel positioning of stop. Smooth cushioning of the piston at the end of each stroke is provided by means of fixed and floating dash pots having adjustable bleeder ports.

Both the crank-driven metering pump and the fluid-operated unit have been described. A basic difference exists between these two.

The clearance volume (that space still remaining in the reagent cylinder with the plunger fully forward in the completed discharge position) is extremely important in metering pumps. It determines if the pump will be self-priming or relieve itself of entrained air when discharging against pressure.

Ratio of total displacement volume to clearance volume will vary in the crank-driven unit as stroke length changes are made, but it will remain constant in the pneumatic type. Ratio for the motor crank pump will be high for maximum stroke (minimum clearance). When the ratio drops below an easily computed value ($P_1 V_1 = P_2 V_2$) the pump will not purge itself of air.

In the pneumatic unit, since stroke length is controlled by limiting the rearward motion of the plunger, the ratio of displacement to clearance volume will not change for different settings.

The motor-driven unit will not reproduce capacity settings at low speeds, because of such factors as fluid viscosity and check-valve efficiency. A hydraulic unit will be uneffected by extremely slow speeds, because each stroke is made at the same speed regardless of frequency. At high stroking rates consideration must be given to fluid viscosity, as sufficient time must be allowed on the suction stroke for the cylinder to fill before discharge is begun.

For small, high-accuracy feeding a modification of the reciprocating positive displacement plunger is available (Fig. 20). This style might better be characterized as a syringe, for it operates exactly like the familiar hypodermic syringe.

A plunger within a cylinder is retracted, and fluid to be metered fills the chamber. The suction is then closed off and the discharge opened. A geared-down drive, with suitable range adjustment, slowly moves the piston forward at a constant rate. Feed is in terms of cc. per hour, and cylinder capacities are designed for four or more hours operation before plunger retraction and refill is required. Units can be dual mounted for continuous operation (while one fills, the other feeds).

Positive displacement pumps are also available in the rotary type, although these are normally in higher-capacity ranges than the reciprocating class. Here types very much akin to those described for positive displacement meters are found. Remember though that now we are externally powering, which makes it a feeder rather than a meter.

Rotary pumps include a sliding vane, swinging vane, shuttle-block, cam and piston, screw, squeegee, plunger and gear (Fig. 21). Types such as sliding vane, shuttle block and plunger have adjustable capacity features, while the others depend on speed variation to produce changes in rate.

The screw pump lends itself particularly to the handling of slurries and suspensions. Aside from this class, others are usually limited to true solutions of little

or no corrosion characteristics as materials of construction are limited. In recent years though, new materials have been making them more suitable for wide chemical application.

Built-in or external pressure relief valves are needed here, as in the case of any positive displacement device. Slip characteristics, pressure differential and fluid viscosity will materially affect accuracy.

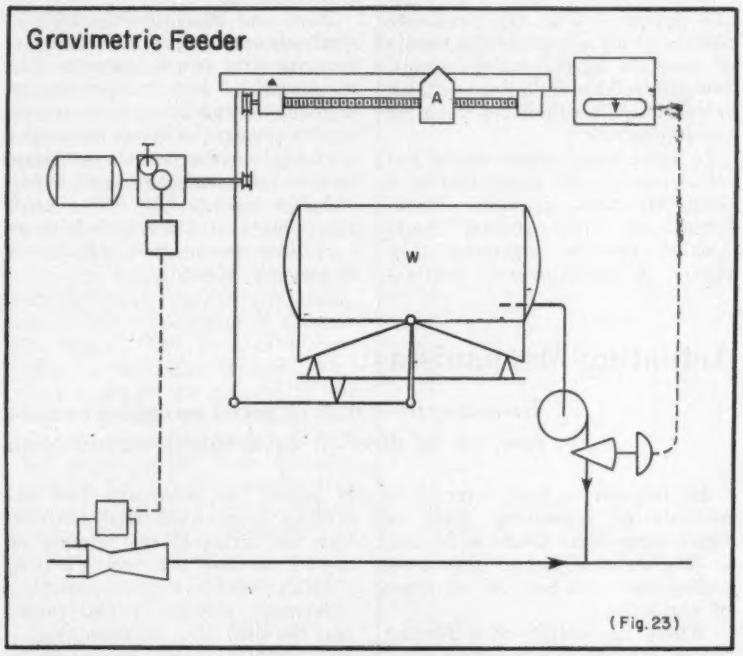
Flow Regulators

Within the same volumetric feeder discussion can be included those metering devices which, with additional items of equipment, become flow regulators.

The metering element, normally used to transmit a recorder, indicator or totalizing signal, can be arranged to deliver this same flow signal to a set point device. This is merely a comparator in which a set rate can be manually established. This represents desired flow rate to be maintained.

The set rate, continuously compared to the meter signal, immediately senses any deviation of actual rate from desired rate. A compensating action is then put into effect normally in the form of some throttling device in the metered stream.

Fig. 22 illustrates a mechanical-pneumatic system in which this type of feed control is exercised. This not only demonstrates flow regulation, but also the principle of continuous feedback. Sensing of flow is continuously reported to a comparator. The comparator delivers, when any deviation from established value exists, a corrective signal to a flow regulating device to bring metered rate back into line with desired signal.



(Fig. 23)

Gravimetric Devices

Their expense is economically justified in those instances where fine accuracy is needed.

Moving now to a review of gravimetric methods of feed and measurement, we find far fewer devices. To feed and meter by weight becomes an expensive method if weigh scale methods are to be used. Yet this expense is economically justified where fine accuracy is needed—such as the case where the liquid being fed is costly, or process requirements are such that plus or minus 1% (or even plus or minus ½ of 1%) limits must be maintained.

Volumetric meter values on differential area devices may be specific gravity compensated to produce a resultant mass flow output. However, accuracy of the meter still prevails. It is difficult to maintain limits better than plus or minus 2%.

Basically, one or more liquid tanks are scale-mounted—and control is exercised over the loss-in-weight of the tank. As shown in Fig. 23, the poise "A" counterbalances the tank and its contents. This in turn is engaged by a finely threaded screw rotating at a rate established by a primary source. This may be a manual setting, or one dependent on a primary flow rate.

In the former, a synchronous motor drive (through an infinitely-variable speed changer, manually set for feed rate) produces the threaded shaft rpm. In the latter, the primary flow signal controls the speed changer setting.

Scale head movement toward unbalance (due to lightening of the scale head without a corresponding reduction of scale tank weight) is immediately sensed by a controller mechanism linked to the scale head. Its set point is established for scale null balance. A movement of the scale in either direction produces a change in controller output signal to a corrective device in the discharge line to process from the scale tank.

This closed loop or feedback system performs exactly the same close feed control as described for the volumetric arrangement in Fig. 22. Our only difference lies in the metering device—in one case it is volumetric, in the other gravimetric.

Where feed rates are such that 4 or 8-hr. requirements necessitate

large scale tank facilities, a dual scale tank arrangement can be used. With this scheme and a large supply tank, one system will be filling while the other is feeding. Then an automatic shifting occurs when the feed tank reaches a preset low level. In this way, the equipment becomes a continuous feed device.

Methods of Control

Meters and feeders can be pre-set for constant rate, or operate in proportion to main flow.

So far the discussion has covered many of the meters and feeders available for liquid proportioning. The important step now is to describe the ways in which they can be combined and controlled, so that continuous production of end product is assured.

In combining liquid, liquid-solid, liquid-solid-gas, etc. flows, consideration must be given to the magnitude of quantities involved.

Some process requirements may call for continuous blending of large quantities. A typical example would be a gasoline blending operation at the rate of 10,000 bbl. per hr. (420,000 gal.). As many as 7 or 8 streams may have to be proportioned at rates varying from 10,000 to 200,000 gph. At the other extreme, the problem may be the injection of minute additive quantities into a flowing stream, where the feed rate of the additive is measured in a fraction of a cc. per min. This may have to be fed to a stream flowing at 1,000 gph.

In addition to this, we have the number of ingredients to be combined. This can range from two to a dozen or more. These may be fed simultaneously or in stepped arrangement—dependent upon reaction time, chemical characteristics, etc.

No matter what the proportioning or blending requirements, any of the liquid meter and/or feed devices previously described can be considered. Each has its particular advantage or disadvantage. Both must be weighed in determining the selection.

Basically, two methods of control are possible—constant rate and flow proportional. Constant rate infers feeding of all ingredients at continuous and equal rates over the entire operation. Flow proportional derives its name from the fact that all feeds are usually pinned on the measurement of a single function. As it varies, rates of all other ingredients automatically vary to keep step or proportion with the lead or pacing signal.

Constant Rate

Constant rate systems will normally provide continuous, fixed-rate feeding of all ingredients by means of positive displacement pumps, flow controllers actuating suitable valves, etc. These devices would be pre-set for rate.

In some cases, these would run continuously until completion of a particular total quantity. Push-button or timer control would usually provide start-stop. In others, it might operate continuously 24 hr. per day for months.

In either case, the total blend rate does not change for any reason. Considerable care must be given to feeding the components at a fully-controlled, fixed rate. Any process deviations causing a change in proportions as originally determined will call for manual resetting.

Flow Proportional

Flow proportional systems become more and more in evidence as industry shifts to the automatic process. This is due primarily to the increasing availability of instruments for signal transmission and control, covering a wide range of measurements.

More and more, the controlled, continuous process can be checked by automatic instrumentation for specifications—and automatically adjusted in the event a measured quality or quantity shows deviation. Majority of these systems hinge on flow rates, although many other variables can furnish the control signal function. These include pressure, level, temperature, pH, specific gravity, viscosity.

Actuating Mechanisms

Secondary flows may be paced according to main flow, or be directed by a closed control loop.

Up to now we have referred to methods of regulating feeds of many ingredients as one of control. In its strictest sense, this term control does not hold for all types of regulation.

Where the output of a feeding device is continuously sensed, compared to the required measurement and adjusted accordingly, a control function is performed in the strictest sense.

Thus, when a primary signal calls for an adjustment in a secondary feed, some device must measure the effect of this change on the primary and report it to a source which will compare it to the pre-set value. If any deviation exists, a correction must occur. This is a closed or feedback loop which is truly controlling.

If, instead of comparing the transmitted primary adjustment signal, we merely allow the signal to adjust the secondary feed according to pre-calibrated settings, then the action of the primary or control medium is a pacing action.

As an example, suppose a primary differential element is used to adjust the feed of a secondary pump in accordance with variations in flow. If we merely use the signal to speed up or slow down the rotary pump delivery rate (according to calibrated values), we refer to this as a paced system. Now if we insert a positive displacement meter in the discharge of the rotary pump, compare this meter signal to the signal governing pump capacity and adjust the amount of liquid in a bypass around the pump, we get a controlled system.

Most of the meters or feeders described can be equipped to transmit and/or receive a varying signal—be it pneumatic, electrical, mechanical or hydraulic. This will

serve to change a speed, re-position the length of a stroke, or adjust a ratioing device.

Let us take a few examples of how the various feeders can be combined to produce a continuous, inline proportioning system which will accurately add the necessary ingredients, mix them and deliver them to storage, carrier, or packaging operation.

Paced System

Fig. 24 represents a composite system which indicates many of the schemes and devices for continuously proportioning and feeding liquids. It is unlikely that any one arrangement would use all of these, but it serves to indicate the many combinations possible.

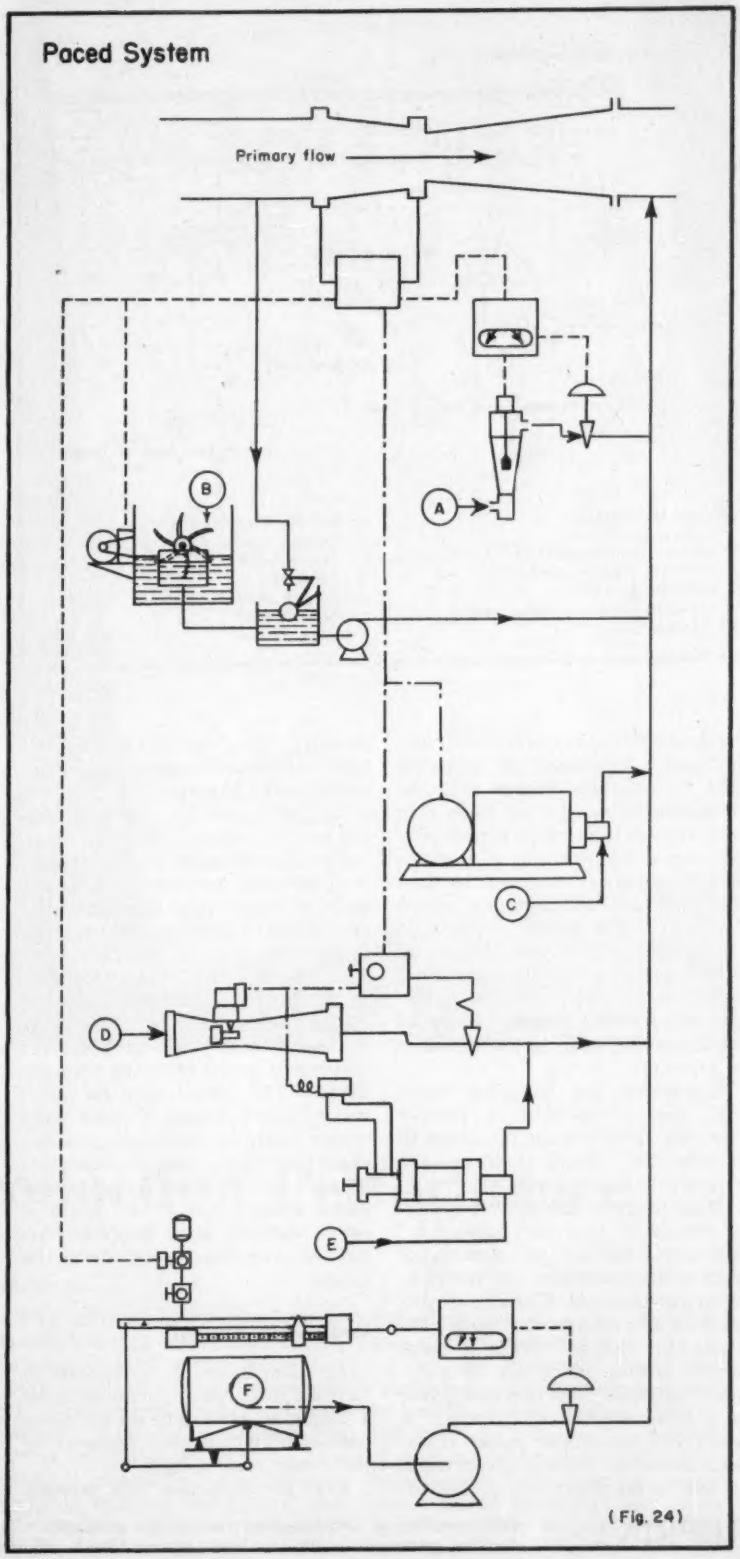
In this instance, fluctuating flow of a primary stream will be used to pace feed rate of all secondary devices. The differential meter-measured variable converted to a proportional flow signal is transmitted as a pneumatic or electrical signal. This will actuate suitable controls on the secondary feed devices to maintain pre-set ratios.

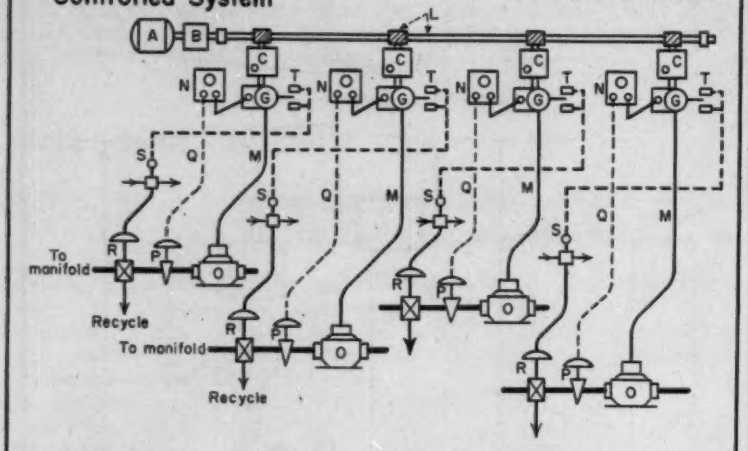
For the liquid "A," a flow regulator device is used. The variable area meter continuously reports flow rate of "A" to a ratio controller—a pneumatic set point controller in which the ratio of "A" to primary stream is manually preset. Additional movement of set point is controlled from primary flow rate fluctuations. Actual flow rate of stream "A" must follow this set point. Any necessary adjustments of flow stream to accomplish this are done through re-positioning of control valve.

Again, liquid "B" feed rate is varied according to a pneumatic flow rate signal from primary. The signal varies a pneumatic positioner setting on a speed changer driving the paddle wheel. An initial setting is made for required feed rate with respect to primary.

This feeder is basically a gravity device. But by incorporating a float box in the discharge (which, in turn, supplies suction for a centrifugal pump), we provide for injection against primary line pressure. The float maintains a liquid level for flooded suction by tap on primary line. Pump is sized to feed at rate exceeding rate of "B."

For addition of "C," a positive-





BILL OF MATERIALS
A – Master drive motor
B – Master variable speed unit
C – Individual variable speed unit
G – Differential unit
L – Takeoff and drive shaft assembly
M – Flexible cable
N – Pneumatic controller
O – Positive control meter
P – Control valve
Q – Air piping
R – Recycle valve
S – Solenoid pilot
T – Limit switches

(Fig. 25)

displacement, motor-operated pump includes adjustment of stroking rate to maintain proper ratio as primary varies. Initial feed rate with respect to primary is manually set. Here the primary signal can be transmitted electrically to vary the speed of an electronic speed changer. Other pumps of this type can be equipped so that a variation in the pneumatic flow proportional signal will reposition the device governing stroke length—so as to maintain pre-set ratio of secondary to primary.

Equipment for handling liquid "D" also incorporates a smaller flow "E," which must be added to stream "D" before it enters the primary or blend line.

Measurement and control of "D" is similar to that for liquid "A." However, instead of pneumatic-mechanical operation, we resort to electro-mechanical. Electrical transmission of primary flow signal (as a varying voltage) drives a pulse output device, which can be regulated for ratio. This drives one side of a pulse stepped differential. A positive-displacement meter transmits contactor signals proportional to flow to the other side of the differential. Any upset in differential will re-position electric motor-operated valve in meter line.

In addition to transmitting pulses for control of "D," contactor also actuates four-way solenoid-operated air valve. This controls stroking rate of pneumatically operated positive-displacement pump injecting "E" into line "D." Ratio of "E" to "D" is established by setting stroke length.

The material "F" will be fed by weight, and the rate of poise retraction is paced from the primary device. The signal may be pneumatic, in which case a speed positioner controls speed of threaded shaft. Or with a time duration impulse, a clutch engages and disengages poise screw drive. Ratio is set on variable speed device on output of variable speed drive or clutch.

Controlled System

In some cases, it is desired to have an integrated system whereby a master source can be set for blend rate—and include the features of the closed control loop.

Fig. 25 illustrates this scheme. A master drive or computer system, that is completely separate from the metering function, controls master blend rate. This is set through an infinitely variable speed changer. At each of the metering stations, a right-angle take-off delivers this speed to individual speed changers which are set for percentage or ratio. These drive individually into one side of mechanical differential units like Fig. 22.

Metered flow rates are delivered to the other side of this differential. Any difference in speed between the two inputs will re-position the spider gear which, through suitable linkage, will unbalance the air controller and cause a repositioning of the throttling valve in the particular line in which this condition occurs. The valve will move to correct this upset condition.

A unique feature of this scheme is the built-in requirement that the spider must return to the setpoint position for the system to be in balance. In doing so, it makes up or eliminates the shortage or overage which caused the upset condition. Any failure of the control mechanism to maintain conditions within set limits will automatically stop the blender operation and actuate suitable alarm devices.

Trends

Electronic devices, computers will play big part.

What will the future trends be in the field of liquid proportioning for the process industry?

For one thing, it is apparent that the tremendous growth of electronic devices will find application here. Data reduction and read-out systems and computers can assemble and analyze a vast number of measurements. Any deviations from setpoint conditions can be sensed and adjustments made without human analysis.

These are possible additions to the array of presently-existing systems which can step-up production, reduce routine labor, and meet the demands of an expanding society. The trend is towards an accelerated pace in developing and incorporating the new equipment as it comes along.

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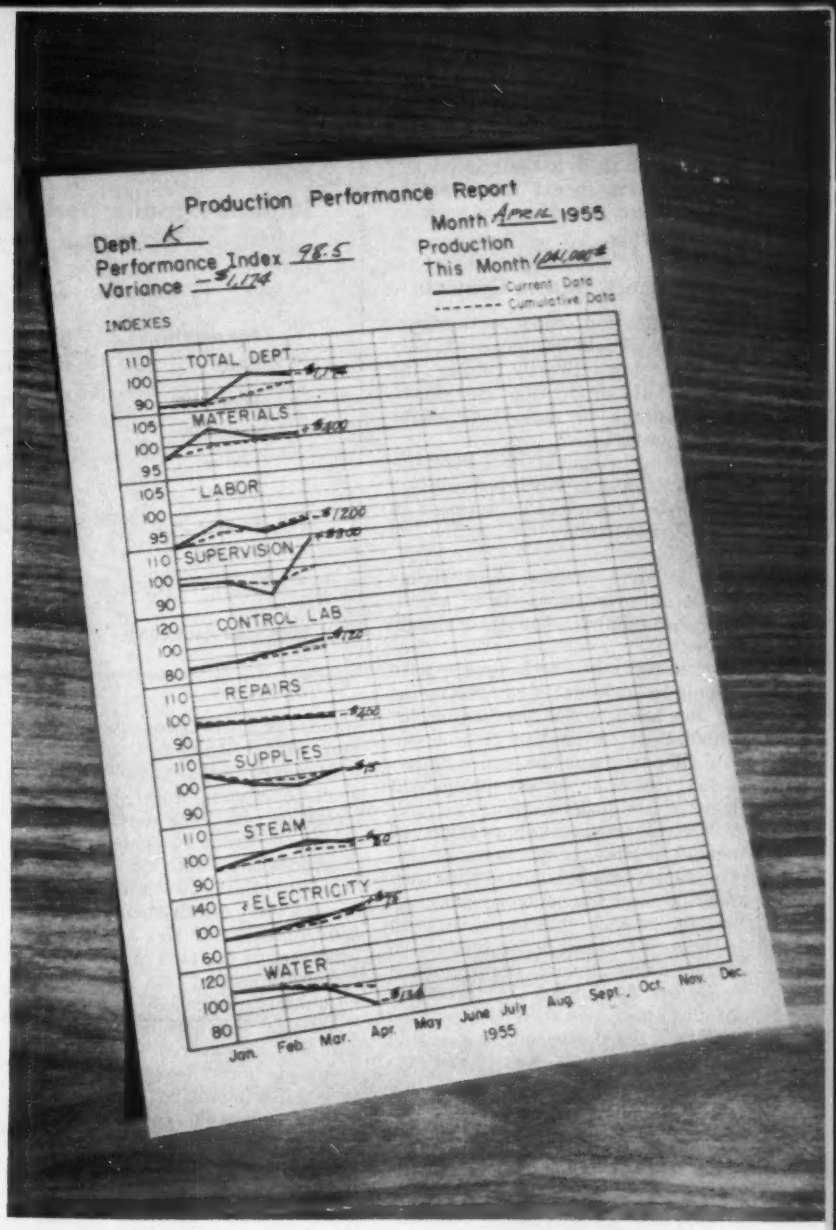


As an important aid to effective management of the men, materials, and equipment under your jurisdiction, we present the means for deriving your own performance indexes.

Methods are simple and results readily comprehended. All you need are standard cost measurements prior to . . .

Evaluating Production Performance

D. V. BIERWERT, Monsanto Chemical Co.

Production management is responsible for converting raw materials to finished products at the lowest possible cost. This responsibility is carried out through the effective use of men, materials and equipment. The reports, which indicate how well these three factors are used, are of prime importance to management and every man in the production organization.

This article will describe how to develop a simple but significant performance report which meets the requirements of production personnel. The report consists of unweighted performance indices for factors controlled by production, a weighted composite summary performance index of the factors, and corresponding dollar variances incurred when specified performance standards are exceeded or when they are not achieved.

Over the course of years, accounting procedures have been developed to meet the needs of modern industry. As industry has become more complex, accounting problems have become correspondingly complex. One of these problems is to furnish production personnel with performance reports that will di-

rectly assist them in their activities. Such reports should meet certain fundamental requirements such as the following.

Performance Report Content

1. Evaluation of production performance should be limited to only those factors directly under the control of production personnel. Such things as price variations should be excluded.
2. Reports should be essentially self-explanatory. No interpretation should be required to determine in what area corrective action is needed.
3. Relative degree and dollar values of variations from established standards should be clearly stated.
4. Reporting technique used should be such that it can be applied to any level of the production organization.
5. Reports must be easily understood from the lowest to highest level of the organization.
6. Evaluation technique employed should permit preparation of reports on a timely basis so that they may be used for control purposes.

Performance indices have been developed to meet these production performance report requirements.

Before describing the derivation of the indices, it should be pointed out that the derivation is based on the use of "standard cost" methods of accounting. Most manufacturing companies have set up cost standards for all products made in their production departments.

Standard "input factor" requirements of steam, water, labor, raw materials, etc., are determined on a quantity basis for a certain unit of production—such as ton, gallon, or pound. Cost of each of these "input factor" requirements is then determined, and the total is the total cost of the unit of production.

Since standard cost methods are adequately described elsewhere in literature, the detailed procedures will not be covered herein. It is assumed that the basic data required for standard cost information is available since it is this information that serves as the reference point for the performance index.

Only those input factors under the complete control of production personnel are to be included in the performance report. This is important, for the report must indicate the degree of performance only in the area where authority is granted for the execution of assigned responsibilities.

Everyone has a sense of pride in his work, either as an individual or as a member of a team. If the results of one's effort are not accurately recorded in the performance report, there can be a resulting sense of frustration. Thus development of a significant report, which accurately reports performance in the execution of responsibilities, can do much to develop individual and team enthusiasm for work well done and so reported.

Summary Index Derivation

	Units	Usage Rate per 100 Lb.	$ (Standard Usage)
Raw materials	Pounds	101.429	1,420,000
Labor	Manhours	0.857	12,000
Supervision	Manhours	0.129	1,800
Control lab	Test units	1.100	15,400
Repairs	Manhours	0.214	3,000
Supplies	Dollars	0.050	700
Steam	M pounds	0.086	1,200
Electricity	Kwh.	0.139	1,950
Water	M cu.ft.	0.100	1,400

Production: 1,400,000 lb.

With this background, let us derive the performance indices as needed to meet the two types of evaluation required:

1. Single Factor Evaluation or Factor Index
2. Composite Multiple Factor Evaluation or Summary Index

The indexes set 100 as par or standard. An index above 100 indicates better than standard performance. Conversely, an index below 100 indicates performance below the established standard.

Factor Index

This index is simply the ratio of standard to actual usage of an input factor expressed as percent and can be represented by:

$$I_f = \frac{S}{A} \times 100$$

I_f = performance index for a single input factor

A = actual quantity of input factor used for reported production total

S = standard quantity of input factor required for the reported production total

Example:

Assume 80,000 lb. of steam were used for the production of 2,000 lb. of product. The standard usage rate established was 30 lb. of steam per pound of product.

A = 80,000 lb. steam

S = 2,000 × 30 = 60,000 lb. steam

$$I_f = \left(\frac{60,000}{80,000}\right) \times 100 = 75$$ performance index for steam

DONALD V. BIERWERT is manager of production control for Monsanto's plastics division, Springfield, Mass. He joined Monsanto in 1943 as a research chemist, then served two years in the navy as a lieutenant j.g. He is a chemical engineering graduate of Princeton University.

A (Actual Usage)	$I_f = S/A \times 100$	S-A	Input Factors Unit Cost	Variance	Std. Cost per 100 Lb. Product	W (Weighting Factor)	$I_f \times W$
1,400,000	101.429	20,000	$0.135/lb.	$2,700	$13.693	0.792	80.335
9,000	133.333	3,000	1.85/mhr.	5,550	1.585	0.092	12.267
2,000	90.000	— 200	2.50/mhr.	— 500	0.323	0.019	1.710
15,000	102.667	400	0.80/lu.	320	0.880	0.051	5.236
5,000	60.000	—2,000	2.10/mhr.	—4,200	0.449	0.026	1.560
1,260	55.556	— 560	....	— 560	0.050	0.003	0.167
800	150.000	400	0.75/M lb.	300	0.065	0.004	0.600
1,400	139.286	550	1.1/kwh.	605	0.153	0.009	1.254
3,000	46.667	—1,600	0.75/M cu.ft.	—1,200	0.075	0.004	0.187
				$3,015	$17.273	1.000	$103.32 = I_t$

The performance index of 75 indicates a below standard "batting average" for steam usage in the production of 2,000 lb. of product.

This simple calculation can be used for any of the input factors used by production. All that is required are the actual and standard *quantity* requirements expressed in their most basic terms as used by production such as:

Input Factor	Units
Raw materials	Pounds, gallons or tons
Labor	Manhours
Supervision	Manhours
Utilities	
Steam	Pounds or 1,000 lb.
Electricity	Kwh.
Water	Cubic feet or 1,000 cu. ft.
Supplies	Dollars
Control lab	Test units
Investment	Dollars

While the performance index for each input factor permits quick and easy evaluation of the "batting average" for each factor, it is incomplete without an indication of the financial effect of variation from 100 or standard.

This financial effect is readily calculated by multiplying the difference between the total standard and actual quantities of each factor required for the reported production by the corresponding unit price of each factor. This can be expressed as:

$(S - A) \times$ unit price = variance

If the performance index is above 100, the dollar total is positive (performance gain). If below 100, the dollar total is negative (performance loss).

Using the example from above:

(60,000 lb. − 80,000 lb.) × $0.90 per 1,000 lb. steam = − $18 variance (performance loss)

Thus if a performance report were issued for the 2,000 lb. of product made, the portion referring to steam would consist of:

	Index	Variance
Steam	75	− $18

This technique can be used in the evaluation of any single input factor for any scope of operation—from a single department to total plant. The only requirements are:

1. Total of actual input factor consumption.
2. Total of standard input factor required for reported production.
3. Standard unit price for the input factor evaluated.

In the evaluation of steam consumption for a plant, the total steam consumption would be determined from meters. The standard steam requirements of each department would be calculated from production totals and standard usage rates, and the standard price of steam is available from existing cost standards.

This type of index is easily understood by every employee and can be made available to everyone. Supervision can use the variance totals to allocate effort to correct poor performance.

Summary Index

The composite multiple factor performance index is a summary index derived by weighting the individual factor indices. Weighting is based on production standard costs. The standard cost of each input factor per standard unit of production is a certain percentage of the total production cost. Total of these percentages when expressed as decimals adds up to unity.

The summary index calculations may be expressed as:

$$I_t = 100\,[(S_1/A_1)\,W_1 + (S_2/A_2)\,W_2 + (S_3/A_3)\,W_3 \ldots + (S_n/A_n)\,W_n]$$

I_t = Summary index

$S_{1,\,2,\,3,\,\ldots\,n}$ = Standard quantities of individual input factors required for reported production.

$A_{1,\,2,\,3,\,\ldots\,n}$ = Actual quantities of individual input factors used for reported production.

$W_{1,\,2,\,3,\,\ldots\,n}$ = Weighting of respective input factors.

Example: "W" Derivation

Only standard production costs are used in deriving W.

Assume:

$62.50 = total standard production cost of 100 lb. of product.

$12.50 = standard production cost for labor per 100 lb. of product.

$12.50/$62.50 = 0.20 = weighting factor for labor.

Note that the standard product cost for each input factor per unit of production is the standard quantity of input factor required per unit of production multiplied by the standard input factor price.

In the above example, the $12.50 for labor was obtained from the standard cost sheets which showed that 6.25 manhours @ $2.00/man-

hour were required to produce 100 lb. of product.

Example: Summary Index

In this example, raw materials have been considered as a single factor for simplicity. Where more than one raw material is involved, the technique which follows can be used to develop a single raw material index.

The table shows the results of all calculations and data necessary for the derivation of a composite multiple factor index. Total variance to correspond to the total index is the sum of the variances for the individual input factor indices.

This summary performance data can be readily prepared on a timely basis. The required information falls into two broad categories—new and existing:

New—Production Data Required

1. Actual production totals.
2. Actual input factor usage totals.

Existing—Data Previously Developed in Standard Cost Derivations

1. Standard input factor usage rates per standard unit of production.
2. Standard price per unit of input factor.
3. Weighting data for individual input factors.

As soon as the new production data are available, all calculations can be immediately initiated. Report frequency can be established at any level as long as production data are available.

When developing the indices for a summary report of multiple departments or plants, the summary indices of the individual input factors should be prepared first, and then the overall summary index. Variances can be totaled without further multiplication effort once the individual factor variances are calculated.

Report Form

Form of the report may be either tabular or graphic depending upon the desires of those receiving the report.

In the tabular form, detail may be modified to suit individual needs. While only the indices and variances may be required by some, others may request complete detail.

In the graphic form (p. 189), only performance indices and variance totals may be plotted. This form provides a good presentation particularly when historical and cumulative year-to-date performance are shown.

Development and use of the performance index is not meant to solve all the problems involved in reporting production performance. Additional reports are necessary to analyze the causes of variations from standards. The performance index report described here fills the need for a quick index for control purposes at any level within the production areas of responsibility.

Also, performance reports for production are not meant to preclude reports that are necessary to indicate the actual financial performance of a company's activities. Such reports may be more general (i.e., summary type) and show actual costs as contrasted to the detailed type based on standards as used in the performance reports. Report requirements and frequencies must suit the needs of the individual company.

To Compare With Other Years

In the examples above, performance was measured against current standards. However, performance improvement since a particular year can be measured if desired. In these studies, the cost standard data for the particular year involved should be used in place of the current cost standard data.

For studies of this type, changes in equipment investment cannot be overlooked. Equipment investment can be included in the evaluation of indices in the same manner as any other input factor. Ratio used for the single factor (investment) evaluation is standard equipment investment for the particular year divided by the current equipment investment expressed in dollars. Investment dollar values in both cases must be converted to the same value basis, since over the years the value of the dollar is not constant.

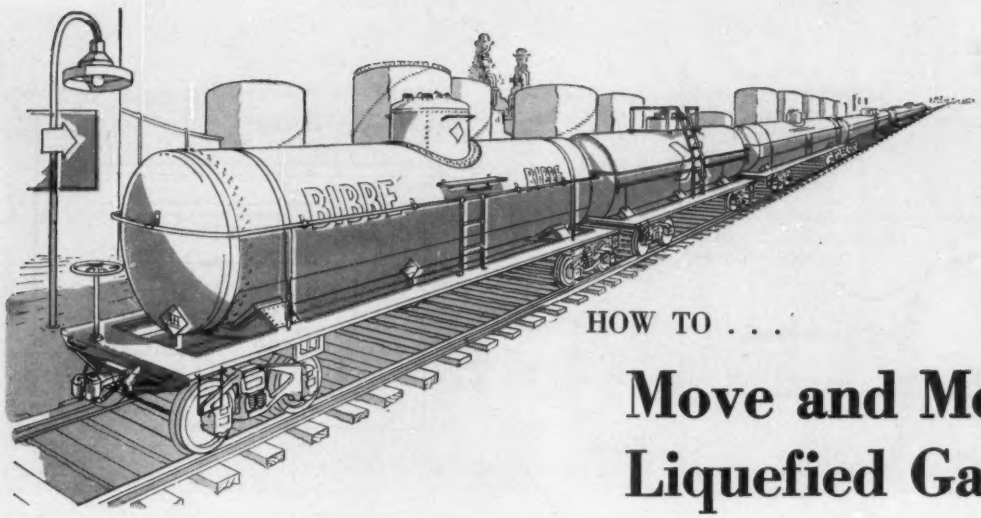
Where equipment installations are relatively fixed, the equipment investment factor is omitted in the performance index calculations. If major changes are made, this equipment factor should be included to obtain a more accurate evaluation of performance when the standard used as reference point remains unchanged. Depreciation charges made against the equipment investment and charged to production activities as shown in the cost standard will then be used to determine W for this input factor.

Production Performance Report

Department M, June 1955
Production: 1,041,000 lb.

Performance Index — 102.5
Variance — $1,571

	Units	S Standard	A Actual	S — A	Index	Variance
Raw material	Pounds	1,300,000	1,290,000	10,000	101	$600
Labor	Manhours	3,400	3,200	200	106	420
Supervision	Manhours	500	600	—100	83	—259
Control lab	Test units	1,200	1,340	—140	90	—180
Repairs	Manhours	500	400	100	125	200
Supplies	Dollars	785	600	185	131	185
Steam	M pounds	3,500	2,300	1,200	152	900
Electricity	Kwh.	760	840	— 80	90	— 95
Water	M cu.ft.	621	873	—152	71	—200
						$1,571



HOW TO . . .

Move and Meter Liquefied Gases

Too often the problems of handling liquefied gases are treated with scant respect. Here are some practical answers that cover most cases.

CHESMAN A. LEE

LIQUEFIED gas under pressure in a tank is at equilibrium with vapor above its surface. In other words, its physical state corresponds to some point on its vapor pressure curve and any physical changes that occur must be along that curve.

This very simple relationship offers unexpected complications in the metering or batch measurement of such materials when discharged to a process. Flow is always involved, and flow is in the direction of diminishing pressure. Vapor forms in proportion to the pressure drop and there is an incidental drop in temperature.

Let's see how this can complicate the operations of moving and metering liquefied gases.

APPLIES TO MANY GASES

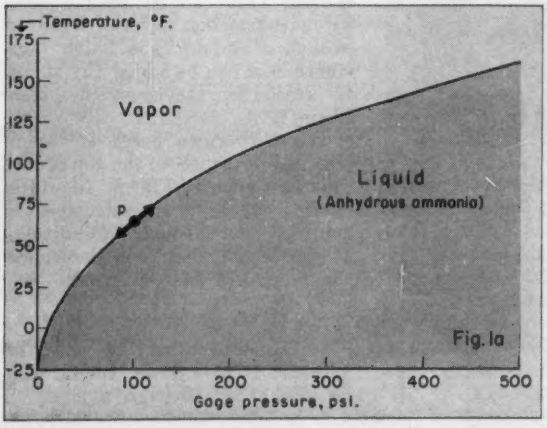
Our discussion could well involve liquefied petroleum gases, chlorine, sulfur dioxide, anhydrous ammonia and other liquefied gases. The problems with LPG are ordinarily minor ones while the problems involved in handling some other gases are more serious. It will be sufficient to base our discussion on one gas only and there seems to be some point in selecting anhydrous ammonia.

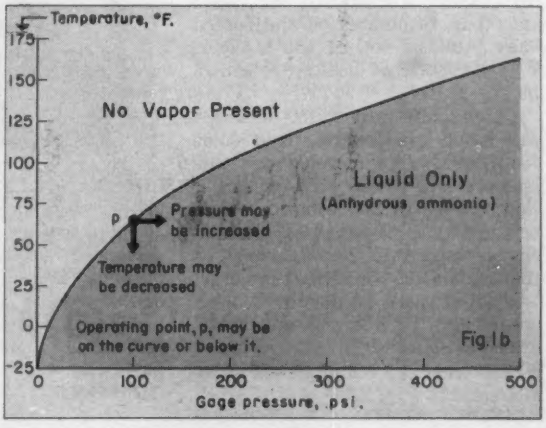
It seems easy to treat ammonia with scant respect. For instance, fertilizer companies are using it in increasing quantities but it is too often assumed that merely ordinary engineering is sufficient. It will be brought out below that even some equipment suppliers are guilty of this kind of thinking.

Fertilizer plants require high rates of production with reasonable accuracy of formulation. Other plants may shift the emphasis. The same basic principles of moving and metering apply.

UNLOADING TANKCARS

When anhydrous ammonia is received in tankcars and unloaded direct to process, as in many fertilizer plants, there are problems which depend on the distance to point of use, the difference in eleva-





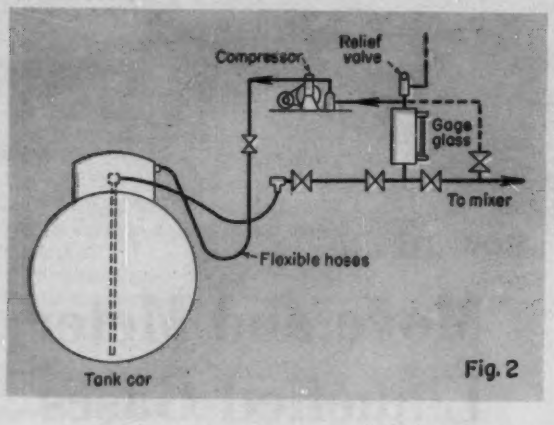


Fig. 2

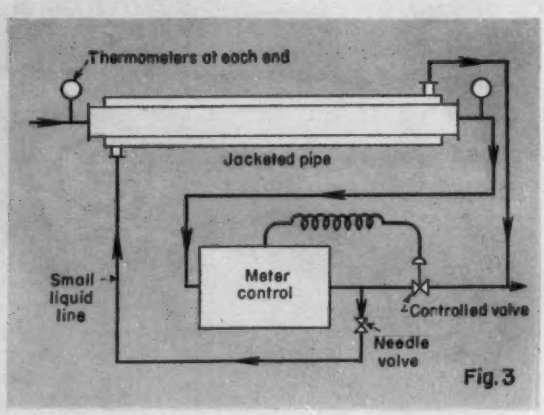


Fig. 3

tion and even the time of year. Such problems and their solutions depend upon the vapor pressure curve.

Let's start with the tankcar. As vapor is present, a sample of liquid can only be represented by some point p on the curve (see Fig. 1a). Temperatures are measured at the surface of the liquid. When liquid is removed from the tankcar, a single change may be forced to the right or downward as shown on Fig. 1a.

Flow is in the direction of diminishing pressure. The corollary statement is that there is pressure drop along the line and marked pressure drop through the control valve. The natural change is downward along the curve by self-refrigeration accompanied by some vaporization along the way. The vapor can slow down the batch measurement, or destroy the accuracy of the metering.

VAPOR RECOMPRESSION

With batch measurement, vapor must vented from the measuring "boot." Preferably, the vapor should be recompressed and forced back into the top of the tankcar. The conventional hookup is shown in Fig. 2.

Often only 1 or 2 lb. of vapor per batch are involved and some fertilizer plants merely vent this amount under the screens rather than bother with a compressor. A better way is to vent past the discharge valve into the mixer pipe as there is always—except at the start—a batch there at the time. Then credit may be allowed, under laboratory control, in the primary measurement. This is shown as an alternate in Fig. 2.

When NH_3 is measured in continuous flow, vapor bubbles cannot be tolerated. There are several solutions all depending on relationships shown on Fig. 1a. Operating points must be forced away from the equilibrium curve far enough to provide for pressure drop along the line and through the meter. Temperature may be lowered, or pressure raised. Both are practicable and it may be desirable to provide for each.

A heat exchanger for subcooling the feed is shown in Fig. 3. Metered liquid bleeds from the upstream side of the control valve and is piped to the jacket. Sufficient vaporization is permitted to get a few degrees temperature drop and ensure condensation of all bubbles. Obviously the method requires that there be appreciable pressure drop through the control valve, and a reasonably high pressure in the tankcar.

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COLD TANKCARS

The tankcar may have been loaded from underground storage and then the liquid will be cool. Or the liquid may have cooled down in cold-weather transit. Tankcars have been received so cold as to greatly slow down the discharge to point of use. Then of course a heat exchanger would be ineffective.

The alternative is to raise the pressure. At the tankcar this is only possible through the addition of heat. An obvious way would be to pump liquid through an external heater and back to the car. However, it is not necessary to heat the entire car.

If the material at the liquid surface in the car is heated, pressure in the car goes up, just as if the entire contents of the car were heated. This can be accomplished by withdrawing several hundred pounds of liquid to a batch tank where heat can be added (by steam if available, otherwise by electricity).

The withdrawn batch is vaporized and returned to the top of the tank as shown in Fig. 4. Liquid is charged as a batch but vapor is returned continuously. Conditions at the actual plant will determine the amount of heat required.

USE A PUMP

It is not necessary to raise the pressure in a tankcar. Liquid may be discharged through a pump to

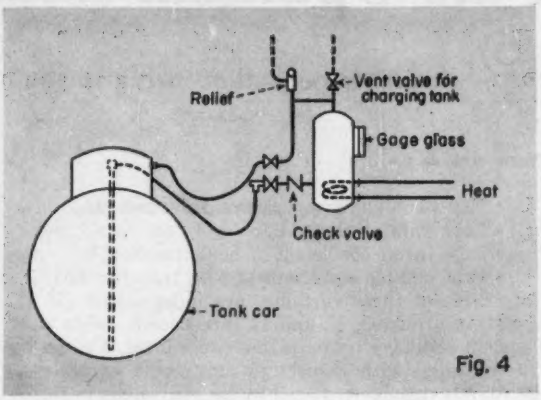

Fig. 4

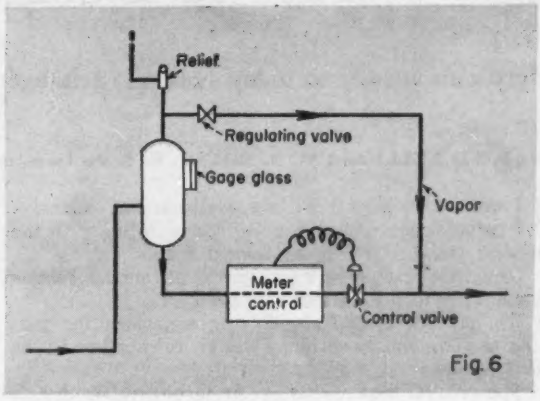

Fig. 6

raise the pressure in transit. Then the pressure will not be the vapor pressure in equilibrium at the temperature of the liquid. The pressure will be higher and no vapor will form.

There is some choice in selecting a pump. One style is the turbo-regenerative shown in Fig. 5. This pump is very effective—with one precaution. There must be no vapor bubbles entering the pump.

Pressure drop over the top of the car and through connections must be compensated for by a positive head. In one case, with the pump set on a dock next to the car, liquid merely flowed through the pump without even a pound increase in pressure. When the pump was set at track level, it worked effectively. Such a pump has a high shut-off head and is more desirable with a cold tankcar.

CONTINUOUS METERING

With the steady flow in continuous measurement, the tankcar is sure to have enough pressure for the low flows that are ordinarily required. The problem is to keep vapor bubbles from passing through the meter.

We would like to emphasize at this point that regardless of the pressure and temperature of the liquid, the liquid is at equilibrium when it leaves the tankcar. The natural flow along the pipeline infers pressure drop and vapor bubbles will form no matter how high the tankcar pressure is.

Using a pump gets away from the problem described above. However, there is an expedient that can be used instead. A vapor-separating tank can be used as shown in Fig. 6, above.

The small amount of vapor involved is sufficient to destroy the accuracy of the metering if the vapor passes through the meter. But if the vapor is bypassed around the meter as shown in Fig. 6, it does not make much difference in the measurement. Some allowance can be made in setting the controls.

Of course, vapor could be recompressed and returned to the car. In any case, the vapor-separating tank should be raised to give a positive head on the meter.

THE PIPING ITSELF

Something should be said about the piping itself. Any contained volume of liquid must have pressure-relief. A "boot" or other tank must have a (refrigeration-type) relief valve with closed discharge piped to the roof.

TURBO - REGENERATIVE PUMP helps with cold tankcars—Fig. 5

Pipelines must have pressure-relief between any two valves. The small acorn type is sufficient since the contained volume is small and the valve merely "spits" briefly if the pipe warms up with the valves closed.

It should be emphasized at this point that pressure developed by thermal expansion of liquid in a closed line bears no relation to the vapor pressure curve. It depends on the "thermo-piezo effect at constant volume." Pressure can amount to over 1,000 psi.

Incidentally, it is this effect that makes rupture discs undesirable—and even unsafe—in protecting a liquid line. In cold weather there may be no gas pocket for expansion below the disc. Complete trust, however, can be put in the refrigeration-type relief valve.

DON'T FORGET HOSES

It is not so obvious that the above argument also refers to tankcar hoses. When the process is shut down at the end of a shift, tankcar valves should be closed.

Then, if valves on the house side are also closed, we have the same problem. Hose is flexible but is wire-wound to the extent that it provides no capacity for liquid expansion.

Hoses have failed frequently. And in some cases they have been replaced free-of-charge because the supplier's engineers couldn't figure out what made them fail. Pressure-relief should always be provided on the hose side of a factory valve.

How to Design the Optimum Heat

Here's an answer to today's rising exchanger costs—simplifying equations that give you an

M. T. CICHELLI and M. S. BRINN, E. I. du Pont de Nemours & Co.

HEAT exchangers have always been an expensive process equipment item—directly in line with the general trend of rising equipment costs.

Designing exchangers for minimum annual cost is one answer to this serious cost problem.

We have developed simplifying equations for getting the economical optimum design for shell-and-tube heat exchangers.

The general heat exchanger problem involves design of a baffled shell-and-tube counterflow exchanger where the following is known: process fluid rate, process fluid temperature change and coolant inlet temperature. Also, tube fluid is in turbulent flow, tube spacing and tube inside and outside diameters are specified.

To be determined are: total surface area, warm-end temperature approach, number and length of tubes, baffle spacing, tube-side and shell-side pressure drop.

Some work has been done on optimum cooling water rate, where U_o, coolant cost, fixed charges and power costs are known.[1, 2]

However, in most cases it's necessary to optimize the tube-side and shell-side velocities before the overall coefficient of heat transfer and the power cost per unit area can be calculated.

The usual solution to this general problem requires trial-and-error attack of two unknowns in a pair of nonlinear equations—each equation containing both unknowns.

However, we get optimum shell-and-tube-side velocities, or coefficients of heat transfer, by solution of *separate* equations, each containing only one unknown. The equations are applicable for the coolant on the shell or tube side of the exchanger. They apply to liquids and to gases undergoing small density changes. Although specific equations for tube and shell-side coefficients have been used, the method of solution is general and may be followed if other equations for these quantities are used.

Minimizing Total Cost

The basic problem is to minimize total annual cost. It equals the sum of coolant cost, heat exchanger depreciation, and the power cost for pumping each fluid:

$$C_T = C_c W_c y + C_A A_o + C_i E_i A_o + C_o E_o A_o \qquad (1)$$

This equation has to be developed into a form involving four variables:

- The warm-end temperature difference, Δt_2
- Tube outside area, A_o
- Tube inside coefficient of heat transfer, h_i
- Tube outside coefficient of heat transfer, h_o

Only three of these variables are independent (if h_i, h_o and Δt_2 are fixed, U_o and Δt_m are known, hence A_o). Thus, in ordinary optimization procedures, C_T can be differentiated with respect to only three variables—the fourth variable replaced by its equivalent in terms of the other three—but the result is a group of very cumbersome equations.

Simplifying Method

The Lagrange multiplier method[4] we use permits differentiation of a modified form of Eq. (1) with respect to all variables, and simplifies the algebra.

Here is how it works: First, W, coolant rate, is related to the warm-end temperature approach by

$$W_c = \frac{Q}{c_c\,(\Delta t_1 - \Delta t_2 + T_2 - T_1)} \qquad (2)$$

E_i, power loss inside tubes, is related to the inside coefficient of heat transfer by

$$E_i = \phi_i h_i^{3.5} \qquad (3)$$

where ϕ_i is defined by Eq. (30).

E_o, power loss outside tubes, is related to h_o

$$E_o = \phi_o h_o^{4.75} \qquad (4)$$

where ϕ_o is defined for in-line or staggered arrangement by Eqs. (40), (43) and (44). Process fluid and coolant viscosities and densities are carried as constants in these equations. This assumes that an adequate close estimate can be made on viscosities and densities, and the error in the estimate will not greatly affect heat transfer coefficients and pressure drops.

If higher precision is needed, the first result can be used for a second, final optimization—but this is probably unnecessary in most instances.

Now we can substitute Eqs. (2), (3) and (4) into (1) to get C_T in terms of Δt_2, A_o, h_i and h_o.

$$C_T = \frac{C_c y Q}{c_c\,(\Delta t_1 - \Delta t_2 + T_2 - T_1)} + C_A A_o + C_i \phi_i h_i^{3.5} A_o + C_o \phi_o h_o^{4.75} A_o \qquad (5)$$

But we need a second equation showing the interdependence of Δt_2, A_o, h_i and h_o. This can be developed from the ordinary heat-exchanger equations $Q = U_o A_o \Delta t_m$; $1/U_o = 1/f_A h_i + 1/h_o + 1/h_i$ and $\Delta t_m = (\Delta t_2 - \Delta t_1)/\ln\,(\Delta t_2/\Delta t_1)$. Eqs. (6), (7), (8). Combining gives

$$\frac{\Delta t_2 - \Delta t_1}{Q \ln\,(\Delta t_2/\Delta t_1)} = \frac{1}{A_o}\left(\frac{1}{f_A h_i} + \frac{1}{h_o} + \frac{1}{h_i}\right) \qquad (9)$$

Using the Lagrange multiplier method Eq. (9) is rewritten:

$$\lambda\left[\frac{\Delta t_2 - \Delta t_1}{Q \ln\,(\Delta t_2/\Delta t_1)} - \frac{1}{A_o}\left(\frac{1}{f_A h_i} + \frac{1}{h_o} + \frac{1}{h_i}\right)\right] = 0 \qquad (10)$$

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Exchanger . . . . . 15 Steps

economic optimum exchanger design.

where the constant λ is the so-called Lagrange multiplier. Combining Eqs. (5) and (10) gives

$$C_T = \frac{C_c y Q}{c_c\,(\Delta t_1 - \Delta t_2 + T_2 - T_1)} + C_A A_o + C_i \phi_i h_i^{3.5} A_o + C_o \phi_o h_o^{4.75} A_o + \lambda \left[\frac{\Delta t_2 - \Delta t_1}{Q \ln (\Delta t_2/\Delta t_1)} - \frac{1}{A_o} \left(\frac{1}{f_A h_i} + \frac{1}{h_o} + \frac{1}{h_t} \right) \right] \quad (11)$$

You can now differentiate this equation with respect to the four variables Δt_2, h_i, h_o and A_o, each derivative set equal to zero. These four equations and the equation for U_o are then used to get values for λ, Δt_2, h_i, h_o and A_o, corresponding to the minimum value for C_T.

The General Problem—Case I

Here, Δt_2, h_i, h_o and A_o are to be optimized—none of these variables are fixed. First differentiate Eq. (11) with respect to h_i:

$$\frac{\partial C_T}{\partial h_i} = 3.5\, C_i \phi_i h_i^{3.5} A_o + \frac{\lambda}{A_o f_A h_i^2} = 0 \quad (12)$$

Then with respect to h_o

$$\frac{\partial C_T}{\partial h_o} = 4.75\, C_o \phi_o h_o^{3.75} A_o + \frac{\lambda}{A_o h_o^2} = 0 \quad (13)$$

Elimination of λ from Eqs. (12) and (13) gives the relation of optimum h_o to h_i

$$h_o = \left(\frac{0.74\, C_i \phi_i f_A}{C_o \phi_o} \right)^{0.17} h_i^{0.78} \quad (14)$$

This is essentially the same result as McAdams.[2] To evaluate h_i and h_o, differentiate Eq. (11) with respect to A_o.

$$\frac{\partial C_T}{\partial A_o} = C_A + C_i \phi_i h_i^{3.5} + C_o \phi_o h_o^{4.75} + \frac{\lambda}{A_o^2} \left(\frac{1}{f_A h_i} + \frac{1}{h_o} + \frac{1}{h_t} \right) = 0 \quad (15)$$

Now we have an equation with h_i as the only unknown (h_o in terms of h_i by Eq. (14), and (λ/A_o^2) in terms of h_i by Eq. (12)):

$$C_A - 2.5\, C_i \phi_i h_i^{3.5} - 2.91\, (C_o \phi_o)^{0.17} (C_i \phi_i f_A)^{0.83} h_i^{3.72} - (3.5\, C_i \phi_i f_A h_i^{4.5})/h_t = 0 \quad (16)$$

This equation can be solved for optimum h_i graphically or by trial-and-error. Once you have h_i, you can get optimum h_o from Eq. (14). Then, knowing film coefficients, you can calculate the over-all coefficient from Eq. (7). Then we are ready to calculate optimum Δt_2.

As we pointed out before, when U_o is known, the optimum coolant rate—determined by Δt_2—can be obtained by the Colburn method, using the graph.

You can get the equation for the graph by differentiating Eq. (11) with respect to Δt_2 and replacing (λ/A_o^2) by Eq. (15) and Q by $U_o A_o/\Delta t_m$. This gives

$$\frac{C_c y U_o}{c_c\,(C_A + C_i E_i + C_o E_o)} = \left(1 + \frac{T_2 - T_1}{\Delta t_1 - \Delta t_2} \right)^2 \left(\ln \left(\frac{\Delta t_2}{\Delta t_1} \right) - 1 + \frac{\Delta t_1}{\Delta t_2} \right) \quad (17)$$

This completes the optimization. An outline of the procedure is shown on p. 197.

Although this method just described is simpler, it is possible to get optimum h_o by replacing terms in Eq. (15) by their equivalents in terms of h_o. This gives equations similar to (16) applying to h_o.

$$h_i = \left(\frac{1.36\, C_o \phi_o}{C_i \phi_i f_A} \right)^{0.22} h_o^{1.29} \quad (14a)$$

$$0 = C_A - 3.16\, (C_i \phi_i)^{0.22} (C_o \phi_o / f_A)^{0.78} h_o^{4.47} - 3.75\, C_o \phi_o h_o^{4.75} - (4.75\, C_o \phi_o h_o^{5.75})/h_t \quad (18)$$

Note that C_A may include cost of liquid hold-up in heat exchanger, if the material is valuable. The cost would be proportional to volume, which is roughly proportional to the surface area.

Coolant Flow Fixed—Case II

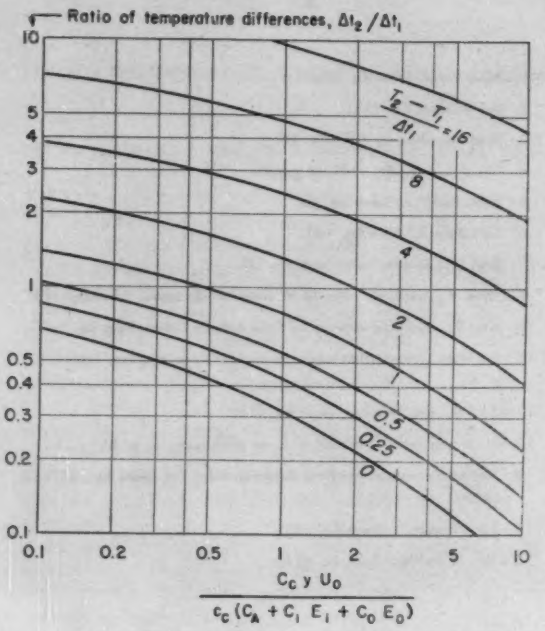
If coolant flow is fixed, Δt_2 is a known constant. The problem then is to optimize tube and shell-side coefficients (or velocities) and the surface area. Since partial differentiation with respect to h_i, h_o and A_o assumes Δt_2 is constant Eqs. (12), (13), (14), (15) and (16) are used unmodified. Optimum values of h_i and h_o are determined, then U_o and A_o calculated (7) and (6). This fixes the design.

Shell-Side Velocity Fixed—Case III

When shell-side velocity is fixed, h_o is a constant. The variables in Eq. (11) are Δt_2, A_o and h_i—two of which are independent. Differentiating Eq. (11) with respect to A_o gives Eq. (15). Differentiating (11) with respect to h_i gives Eq. (12). Equations (12) and (15) are then combined, eliminating (λ/A_o^2).

$$C_A + C_o \phi_o h_o^{4.75} - 2.5\, C_i \phi_i h_i^{3.5} - 3.5\, C_i \phi_i f_A h_i^{4.5} (1/h_o + 1/h_t) = 0 \quad (19)$$

1. Solve for h_t from Eq. (16)
2. Get h_o from Eq. (14)
3. Then calculate U_o from Eq. (7)
4. Get Δt_2 from Eq. (17) or graph
5. Solve for Δt_m from Eq. (8)
6. Calculate A_o from Eq. (6)
7. And W_c, coolant rate, from Eq. (2)
8. Then V_i, average velocity of fluid inside tubes, from Eq. (29)
9. And V_o, average velocity of fluid outside tubes, from Eq. (42)
10. S_i, total cross-section area normal to flow in tubes, from $W_i/\rho_i V_i$
11. And N_t, no. of tubes, from Eq. (24)
12. Minimum cross-sectional area at shell axis, $S_o = W_o/\rho_o V_o$
13. No. of clearances for flow between tubes, N_c from Eqs. (37) or (38)
14. Tube length, L, from Eq. (25)
15. No. of baffles, from Eq. (34)



Eq. (19) can be solved graphically, or by trial and error for optimum h_i. This fixes U_o, and you get optimum flow rate from the graph.

If shell-side pumping costs can be neglected, $C_o = 0$, use Eq. (19) and solve for h_i, eliminating the second term containing C_o. Evaluating h_i fixes U_o and you get optimum coolant rate from the graph.

This solution can be applied to condensation on the outside of tubes, where the coefficient of heat transfer for condensation would not vary much with tube-side coolant velocity and flow rate.

If $C_o = 0$, and h_o and h_f are much greater than h_i, the last term on the left-hand side of Eq. (19) may be neglected, and you can solve for h_i explicitly.[5]

Tube-Side Velocity Fixed—Case IV

Here h_i is constant, and Δt_2, A_o and h_o are variables in Eq. (11). Development follows similar to Case III. Differentiate Eq. (8) with respect to A_o and set equal to zero. Combine with Eq. (13) to give

$$C_A + C_i \phi_i h_i^{3.5} = 3.75\, C_o \phi_o h_o^{4.75} - 4.75\, C_o \phi_o h_o^{5.75} (1/h_i f_A + 1/h_i) = 0 \qquad (20)$$

You get the optimum h_o value from this equation graphically or by trial-and-error. This fixes U_o and the graph is used to get optimum cooling rate.

Similarly to Case III, if the tube-side pumping cost may be neglected, $C_i = 0$ and Eq. (20) is used to solve for h_o with the second term eliminated. If h_i and h_f are much greater than h_o the last term on the left-hand side of Eq. (20) may be neglected, and h_o solved for explicitly.

Surface Area Fixed—Case V

In some cases, the size, weight or holdup volume of a heat exchanger is fixed. These quantities are proportional or nearly proportional to the surface area

Continued on page 200

NOMENCLATURE

- $A_{l.m.}$ — Logarithmic means of inside and outside tube surface area, sq. ft.
- A_i — Inside tube surface area, sq. ft.
- A_o — Outside tube surface area, sq. ft.
- a_c — Ratio of smallest pitch to tube diameter, dimensionless
- a_p — Ratio of pitch parallel to flow to tube diameter, dimensionless (pitch equals center to center distance)
- a_t — Ratio of pitch transverse to flow to tube diameter, dimensionless
- C_A — Annual cost of heat exchanger per unit outside tube surface area. \$/(sq. ft.)(yr.)
- C_c — Cost of coolant, \$/lb. mass
- C_i — Annual cost of supplying 1 ft.-lb./hr. to pump fluid flowing inside tubes, (\$) (hr.)/(ft.-lb. force)(yr.)
- C_o — Annual cost of supplying 1 ft.-lb./hr. to pump shell-side fluid, (\$) (hr.)/(ft.-lb. force)(yr.)
- C_T — Total annual cost, \$/yr.
- c — Specific heat at constant pressure, Btu./(lb. mass) (F.)
- c_f — Specific heat at constant pressure at a temperature midway between bulk shell-side fluid temperature and outside tube-wall temperature, Btu./(lb. mass)(F.)
- D_i — Tube inside diameter, ft.
- D_o — Tube outside diameter, ft.
- E_i — Power loss inside tubes per unit outside tube area, (ft.-lb. force)/(sq. ft.)(hr.)
- E_o — Power loss outside tubes per unit outside tube area, (ft.-lb. force)/(sq. ft.)(hr.)
- f — Friction factor, dimensionless
- f' — Friction factor for flow across tube banks, dimensionless
- f_A — A_i/A_o
- f_i — Fouling factor for inside tube wall, [Btu./(hr.)(sq. ft.)(F.)]$^{-1}$
- f_o — Fouling factor for outside tube wall, [Btu./(hr.)(sq. ft.)(F.)]$^{-1}$
- G_i — Mass velocity inside tubes, (lb. mass)/(hr.)(sq ft.)
- G_o — Mass velocity for flow across tubes, based on minimum free area for flow at the shell axis, (lb. mass)/(hr.)(sq. ft.) (either in transverse or diagonal openings)
- g_c — Conversion factor, (ft.) (lb.-mass)/(lb.-force) (hr.)^2 $g_c = (32.17)\ (3600)^2 = 4.18 \times 10^8$
- h_i — Coefficient of heat transfer inside tubes, Btu./(hr.)(sq. ft.)(F.)
- h_o — Coefficient of heat transfer outside tubes, Btu./(hr.)(sq. ft.)(F.)
- h_t — Combined coefficient for tube wall and dirt films, based on tube outside area Btu./(hr.)(sq. ft.)(F.);

$$\frac{1}{h_t} = \frac{L' A_o}{k_w A_{l.m.}} + f_i \frac{A_o}{A_i} + f_o$$

- k — Thermal conductivity of fluid, Btu/ (hr.) (ft.) (F.)
- k_f — Thermal conductivity of fluid at a temperature midway between bulk shell-side fluid temperature and outside tube-wall temperature, Btu./(hr.)(ft.)(F.)
- k_w — Thermal conductivity of tube wall, Btu./(hr.)(ft.)(F.)

What the Phi Constants Represent

INSIDE THE TUBE

The energy consumption per unit area is given by

$$E_i = \frac{\Delta p_i W_i}{\rho_i A_o} = \frac{\Delta P_i V_i S_i}{A_o} \quad (23)$$

Now

$$S_i = N_t \pi D_i^2/4 \quad (24)$$

and

$$A_o = N_t \pi D_o L \quad (25)$$

Also

$$\Delta p_i = \frac{2fL}{D_i} \frac{\rho_i V_i^2}{g_o} \quad (26)$$

where f may be expressed as follows for N_{Re} between 5,000 and 200,000

$$= \frac{0.046}{N_{Re}^{0.2}} \quad (27)$$

Combining Eqs. (23), (24), (25), (26) and (27), we have

$$E_i = \frac{0.023\ \mu_i^{0.2} D_i^{0.8} \rho_i^{0.8} V_i^{2.8}}{g_o D_o} \quad (28)$$

For flow inside tubes where $N_{Re} > 10{,}000$, the heat-transfer coefficient is related to V_i by the Sieder and Tate[9, 6] correlation

$$\frac{h_i D_i}{k_i} = 0.027 \left(\frac{\mu_i}{\mu_w}\right)^{0.14} \left(\frac{D_i V_i \rho_i}{\mu_i}\right)^{0.8} \left(\frac{c_i \mu_i}{k_i}\right)^{1/3} \quad (29)$$

Rearranging Eq. (29) to solve for V_i, and substituting the result into Eq. (28), you get

$$E_i = \phi_i h_i^{2.5} \quad (3)$$

where

$$\phi_i = 7{,}100 \left(\frac{\mu_w}{\mu_i}\right)^{0.43} \frac{\mu_i^{1.84} D_i^{1.8}}{c_i^{1.16} k_i^{2.32} \rho_i^2 g_o D_o} \quad (30)$$

OUTSIDE THE TUBE

For flow across tubes, in baffled, counterflow heat exchangers, the power loss per unit area is given by

$$E_o = \frac{\Delta p_o W_o}{\rho_o A_o} = \frac{\Delta p_o G_o S_o}{\rho_o A_o} = \frac{\Delta p_o V_o S_o}{A} \quad (31)$$

where S_o is the minimum cross-sectional area for flow at the shell axis and G_o is the maximum mass velocity at the shell axis.

The pressure drop on the shell side of the exchanger may be expressed as follows:

$$\Delta p_o = a_b a_P a_L \left(\frac{2f' G_o^2 N_r n_b}{g_o \rho_o}\right) \quad (32)$$

where a_b is a correction factor (greater than 1) applied to include the friction loss in the baffle cut-offs, which is often set at a certain fraction of the total shell-side pressure drop; a_P is a correction factor (slightly greater than 1) to allow the variation in maximum mass velocity in a nonrectangular tube bundle; and a_L is a correction factor (less than one) to account for the leakage through the tube-baffle and baffle-shell clearances.

The value of a_P is frequently taken as equal to one. The data of Pierson[7] and Huge[8] on pressure drop in flow across tube bundles have been correlated by Grimison[6] in the form of charts, and approximated by Jakob[10] in equation form. Jakob's equations are presented in McAdams,[5] as follows:

L'	Thickness of tube wall, ft.
L	Length of tubes, ft.
n_b	Number of baffle spacings on shell side, = number of baffles plus 1
N_c	Number of clearances for flow between tubes across shell axis
N_r	Number of rows of tubes parallel to flow
N_{Re}	Reynolds number, dimensionless, $= DG/\mu$
N_t	Number of tubes in exchanger
Δp_i	Pressure drop for flow through tube side, (lb. force)/sq. ft.
Δp_o	Pressure drop for flow through tube side, (lb. force)/sq. ft.
Q	Heat-transfer rate in heat exchanger, Btu./hr.
S_i	Total cross-sectional area normal to flow inside tubes, sq. ft.
S_o	Minimum cross-sectional area for flow at the shell axis, sq. ft. (either in transverse or diagonal openings.)
T_1	Outlet temperature of process fluid, F.
T_2	Inlet temperature of process fluid, F.
t_1	Inlet temperature of coolant, F.
t_2	Outlet temperature of coolant, F.
Δt_1	T_1-t_2, = cold-end temperature difference
Δt_2	T_2-t_1, = warm-end temperature difference
Δt_m	Logarithmic mean temperature difference
U_o	Over-all coefficient of heat transfer, based on outside tube area, Btu./(hr.)(sq. ft.)(F.)
V_i	Average velocity of fluid inside tubes, ft./hr.
V_o	Average velocity of fluid inside tubes, ft./hr. axis, ft./hr.=G_o/S_o
W_c	Coolant rate, lb./hr.
W_i	Flow rate of fluid inside tubes, lb./hr.
W_o	Flow rate of fluid outside tubes, lb./hr.
y	Operating hours per year
a_b	Ratio of total pressure drop in shell to pressure drop across tube bundles neglecting pressure drop around the baffle cut-offs
a_L	Correction factor to allow for leakage through baffle clearances
a_P	Correction factor to allow for variation in the maximum mass velocity across the heat exchanger tube bundle
β_o	Constant defined by Eq. (40)
γ_o	Constant defined by Eq. (43)
ρ_i	Density of fluid inside tubes, lb. mass/cu. ft.
ρ_o	Density of fluid outside tubes, lb. mass/cu. ft.
μ	Viscosity of fluid, (lb. mass)/(hr.)(ft.). = 2.42 × cp.
μ_f	Viscosity of fluid at a temperature midway between bulk shell-side fluid temperature and tube outside wall temperature, (lb. mass)/(hr.)(ft.)
μ_w	Viscosity of fluid at tube wall temperatures, (lb. mass)/(hr.)(ft.)

Subscripts

c	coolant
f	film temperature, midway between bulk fluid and wall temperature
i	inside the tubes
o	outside the tubes
w	wall

PHI CONSTANT OUTSIDE THE TUBE, *continued*

$$f' = \left[0.23 + \frac{0.11}{(a_t - 1)^{1.08}}\right]\left[\frac{D_o G_o}{\mu_{f,o}}\right]^{-0.15} \quad \text{(staggered)} \quad (33a)$$

$$f' = \left[0.044 + \frac{0.08 a_p}{(a_t - 1)^{0.43 + 1.13/a_p}}\right]\left[\frac{D_o G_o}{\mu_{f,o}}\right]^{-0.15} \quad \text{(in-line)} \quad (33b)$$

Now

$$S_o = N_o L D_o (a_c - 1)/n_b \quad (34)$$

and

$$A_o = N_t \pi D_o L \quad (35)$$

Therefore

$$\frac{S_o}{A_o} = \frac{N_c (a_c - 1)}{n_b N_t \pi} \quad (36)$$

N_c is related to N_t in accordance with the tube layout selected. For tubes filing a cylindrical shell, McAdams[2] gives a relationship which may be rewritten as follows:

With square pitch and $N_t > 25$

$$N_c = 1.37 N_t^{0.475} + 1 \quad (37)$$

With equilateral pitch and $N_t > 20$

$$N_c = 1.94 + [(N_t - 3.7)/0.907]^{1/2} \quad (38)$$

Combining Eqs. (31), (32), (33a), (33b) and (36) you get

$$E_o = \beta_o V_o^{1.85} \quad (39)$$

$$\beta_o = \frac{2 a_1 a_2 a_L \left[0.23 + \frac{0.11}{(a_t - 1)^{1.08}}\right] \mu_f^{0.15} N_r N_c (a_c - 1) \rho_o^{0.85}}{\pi g_c N_t D_o^{0.15}} \quad \text{(staggered)} \quad (40a)$$

$$\beta_o = \frac{2 a_1 a_2 a_L \left[0.044 + \frac{0.08 a_p}{(a_t - 1)^{0.43 + 1.13/a_p}}\right] \mu_f^{0.15} N_r N_c (a_c - 1) \rho_o^{0.85}}{\pi g_c N_t D_o^{0.15}} \quad \text{(in-line)} \quad (40b)$$

The ratio $(N_r N_c)/N_t$ depends on the tube layout, and is generally predetermined. For rectangular tube bundles, this ratio equals one. For other layouts, value range between 0.7 and 1.2.

The coefficient of heat transfer on the outside of tubes in tube bundles, for film Reynolds numbers exceeding 2,000, is given by McAdams[2] as follows for staggered:

$$\frac{h_o D_o}{k_{f,o}} = 0.33 \left(\frac{D_o G_o}{\mu_{f,o}}\right)^{0.6} \left(\frac{c\,\mu}{k}\right)^{1/3}_{f,o} \quad (41a)$$

For in-line

$$\frac{h_o D_o}{k_{f,o}} = 0.26 \left(\frac{D_o G_o}{\mu_{f,o}}\right)^{0.6} \left(\frac{c\,\mu}{k}\right)^{1/3}_{f,o} \quad (41b)$$

The effect of leakage through the clearances between the tubes and baffles and between the baffles and shell is often allowed for by multiplying the coefficient obtained from Eq. (41) by the factor 0.6. Employing this factor, the shell-side coefficient becomes

$$h_o = \gamma_o V_o^{0.6} \quad (42)$$

where for staggered

$$\gamma_o = \frac{0.198\, c_f^{1/3} k_f^{2/3} \rho_o^{0.6}}{\mu_f^{0.27} D_o^{0.4}} \quad (43a)$$

or for in-line

$$\gamma_o = \frac{0.156\, c_f^{1/3} k_f^{2/3} \rho_o^{0.6}}{\mu_f^{0.27} D_o^{0.4}} \quad (43b)$$

Substituting Eq. (42) into (39), we have

$$E_o = \phi_o h_o^{1.75} \quad (4)$$

where

$$\phi_o = \beta_o / \gamma_o^{1.75} \quad (44)$$

and β_o is given by Eq. (40) and γ_o by Eq. (43).

A_o when tube diameter, wall thickness and tube pitch are specified. Variables in Eq. (11) are then Δt_2, h_i and h_o; two of which are independent.

Differentiation with respect to h_i and then h_o gives Eqs. (12), (13) and (14). With respect to Δt_2 Eq. (11) yields

$$\frac{\partial C_T}{\partial \Delta t_2} = \frac{C_d y Q}{c_c (\Delta t_i - \Delta t_2 + T_2 - T_1)^2} + \frac{\lambda}{Q}\left[\frac{1}{\ln(\Delta t_2/\Delta t_1)} - \frac{(\Delta t_2 - \Delta t_1)}{\Delta t_2 \ln^2(\Delta t_2/\Delta t_1)}\right] = 0 \quad (21)$$

Replacing λ with its value from Eq. (12), and solving for h_i.

$$h_i = \left[\frac{C_d y Q^2}{(3.5\, c_c)\,(C_i \phi_i f_A A_o^2)\,(X)^2\,(Y)}\right]^{0.22} \quad (22)$$

where

$$X = \Delta t_1 - \Delta t_2 + T_2 - T_1$$

$$Y = \frac{1}{\ln(\Delta t_2/\Delta t_1)} - \frac{\Delta t_2 - \Delta t_1}{\Delta t_2 \ln^2(\Delta t_2/\Delta t_1)}$$

This is a little cumbersome, though straightforward. Several alternatives exist. One is to assume a value for Δt_2, calculate h_i from Eq. (22), calculate Δt_m from (8) and U_o from (6), solve for h_o from h_i from Eq. (14), get U_o from (7) and compare this value with the first U_o. If unequal, assume a new value for Δt_2, and repeat the process until the U_o values check. You can speed this up by plotting difference between two values of U_o against assumed Δt_2 values.

Coupled Systems

For extension of these techniques to coupled systems—atomic power plants, liquid-cooled engines, and the like—requires adding the cost of operation of the primary system to Eq. (1).

If this is constant, or a function only of heat load, Q, the equations developed here can be used unchanged. Minimum cost per unit power, (C_T/Q) may be obtained by heat-exchanger optimization of several power-levels, and plotting C_T/Q vs. Q for selection of the minimum.

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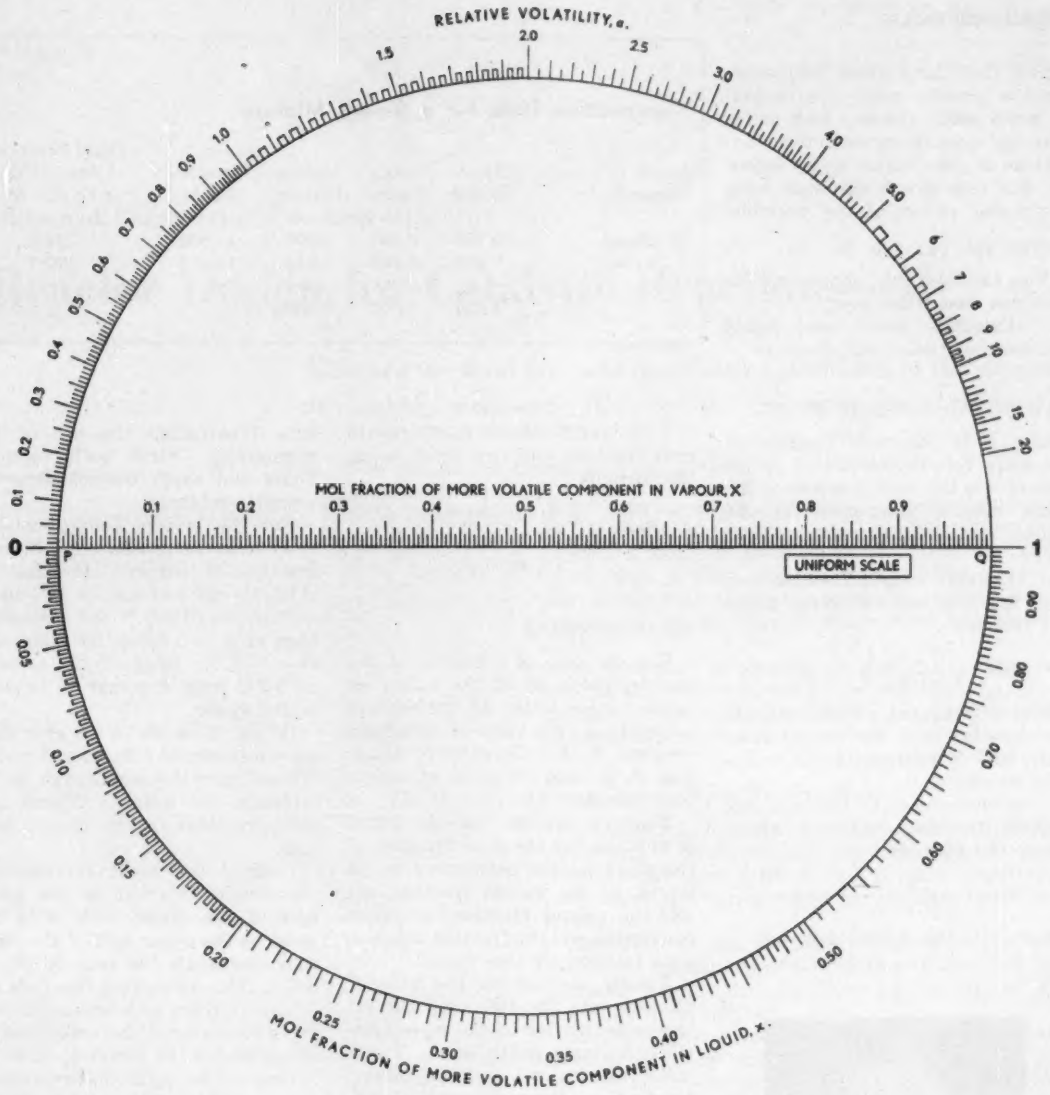

RELATIVE VOLATILITY, α.
MOL FRACTION OF MORE VOLATILE COMPONENT IN VAPOUR, X
UNIFORM SCALE
MOL FRACTION OF MORE VOLATILE COMPONENT IN LIQUID, x.

Vapor-Liquid Values Made Easy

This new circular nomograph for vapor-liquid equilibrium helps cut your calculation time to an absolute minimum. Useful also for interrelating weights, volumes, mole fractions of binary mixtures.

J. F. VOORWIJK, N. V. De Bataafsche Petroleum Maatschappij

ALTHOUGH several nomographs have already been published for estimating vapor-liquid equilibrium values in binary mixtures, the presentation above can boast of several definite advantages.

The scale for the relative volatility—or the ratio of molecular weights—which is a variable over a wide range, is plotted on the upper half of the circle. Circular plotting allows more graduations to be shown than on a straight-line scale.

When you use this nomograph, the unknown value that is sought in most cases can be read off the uniform horizontal scale. Interpolation by sight on this scale is, by far, easier than on any other scale.

This chart, in contrast with

others that have been published, gives a greater scale distribution to small scale values. And moreover, the spacings between the graduations on the circular scales shown on this nomograph decrease with increasing values of the variable.

WHERE YOU CAN USE IT

You can use this nomograph to save you time when you:

• Calculate vapor and liquid compositions using the formula

$$X = \frac{\alpha x}{1 + (\alpha - 1) x}$$

where X is the mole fraction of the more volatile component in the vapor; x is the mole fraction of the more volatile component in the liquid; and α is the relative volatility.

• Convert weight fraction into mole fraction, and vice versa, using the formula

$$m_1 = \frac{(d_2/d_1)\, w_1}{1 + [(M_2/M_1) - 1]\, w_1}$$

where m is the mole fraction; d is the density; w is the weight fraction; and M represents the molecular weight.

• Convert weight fraction into volume fraction, and vice versa, using the formula

$$v_1 = \frac{(d_2/d_1)\, w_1}{1 + [(d_2/d_1) - 1]\, w_1}$$

where v is the volume fraction.

J. F. VOORWIJK qualified in mechanical engineering at the Technical High School Amsterdam and was active for a number of years in the cane sugar industry of Java. In 1937 he joined the Bataafsche Petroleum Maatschappij (Royal Dutch/Shell Group) where he is now engaged in developing computation methods to aid design.

Composition Data for a Binary Mixture

Liquid Composition	Weight Fraction	Mole Fraction	Volume Fraction	Molecular Weight	Liquid Density at 1 Atm., 15°C., in Kg./Cu. M.
1) Ethanol.....	0.750	0.540	0.790	46.068	794.3
2) Water.....	0.250	0.460	0.210	18.016	999.1
	1.000	1.000	1.000		

• Convert volume fraction into mole fraction, and vice versa, using the formula

$$m_1 = \frac{[(M_2/d_2)/(M_1/d_1)]\, v_1}{1 + \left[\left(\frac{M_2/d_2}{M_1/d_1}\right) - 1\right] v_1}$$

FOR CONVENIENCE

For the sake of convenience, we can designate all of the following values by the letter A: the relative volatility, α; the ratio of molecular weights, M_2/M_1; the ratio of densities, d_2/d_1; and the ratio of molecular volumes, $(M_2/d_2)/(M_1/d_1)$.

Similarly we can use the letter B to stand for the mole fraction of the more volatile component in the liquid, x; the weight fraction, w_1; and the volume fraction, v_1 (when converting weight fraction into volume fraction, or vice versa).

Finally, we can use the letter C to designate the following values: the mole fraction of the more volatile component in the vapor, X; the mole fraction, m; and the volume fraction, v_1 (when converting volume fraction into mole fraction, and vice versa).

ONE FORMULA SOLVES ALL

The consequence of these substitutions is that we may express all of the above formulas in a single formula, as follows:

$$C = \frac{AB}{1 + (A - 1) B}$$

The circular nomograph on the previous page is a plot of this equation. Select a value of A on the upper half of the circle and a value of B on the lower half of the circle.

Consider A and B to be the independent variables. Then, C is a dependent variable that can be read off the center straight-line scale of the nomograph.

Let's work out some sample problems illustrating the use of the nomograph. First we'll compute liquid and vapor compositions for a simple mixture.

For the system benzene-toluene at a liquid composition of 0.20 mole fraction of benzene, the relative volatility can be taken as 2.37 under certain conditions.* Set a straight edge at $x = 0.20$ on the chart and at $\alpha = 2.37$. Read off the value X as 0.372 mole fraction of benzene in the vapor.

In the table above we give data for a mixture of ethanol and water. We will use the nomograph to interrelate the weight, volume and mole fractions in this binary mixture.

Connect the point representing the weight fraction on the lower half of the circle, 0.75, with the point on the upper half of the circle that represents the ratio $M_2/M_1 = 0.391$. The connecting line cuts the center uniform scale at a point that gives the value of the mole fraction of ethanol in the mixture, 0.540.

Connect the point that represents the weight fraction on the lower half of the circle, 0.75, with the point on the upper half of the circle that represents the ratio of densities, $d_2/d_1 = 1.258$. The connecting line cuts the center uniform scale at a point that gives the desired value of the volume fraction of ethanol in the mixture, 0.790.

Connect the point representing volume fraction on the lower half of the circle, 0.790, with the point on the upper half of the circle that represents the ratio of molecular volumes, 0.311. The connecting line cuts the center uniform scale at a point that gives the value of the mole fraction of ethanol in the mixture, 0.540.

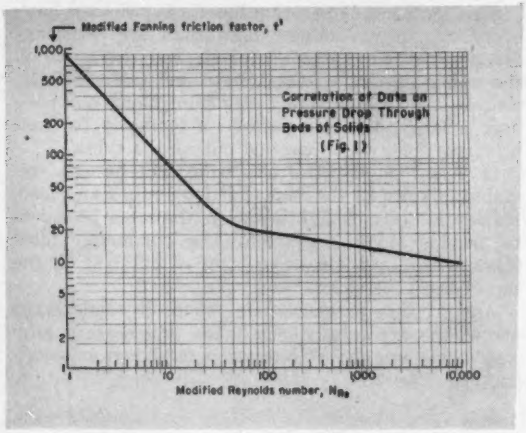
*See J. H. Perry, "Chemical Engineers' Handbook," 3rd. Edition, p. 526 McGraw-Hill Book Co., Inc., New York (1950).

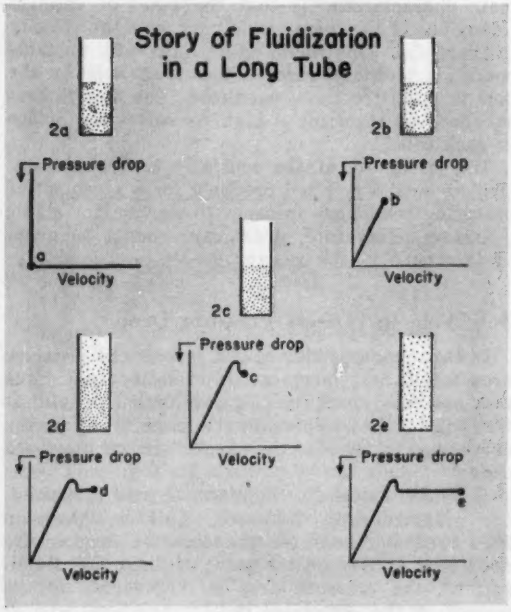
Chemical Engineering Fundamentals

Reactor Design for Catalytic Reactions—II

What are the fluid flow and distribution problems in the design of catalytic reactors? Here are the factors to be considered.

T. E. Corrigan and W. C. Mills, Olin Mathieson Chemical Corp.





LAST month we discussed the factors that must be considered by a chemical engineer when he designs a catalytic chemical reactor (*Chem. Eng.*, April 1956, p. 197). Because the problem of even gas distribution through a catalytic reactor is so important, we will devote this entire installment to it.

We will want to consider some of the qualitative aspects that are involved in the problem of maintaining uniform gas flow through a parallel-tube fluidized-bed reactor.

Long Tubes With No Overflow

Consider first a single tube which is only partially filled with a finely divided catalyst. Fig. 1 is a plot showing how friction factor—and therefore, pressure drop—varies with the modified Reynolds number.

However, we can visualize a clearer picture of the actual mechanism of fluidization if we think in terms of pressure drop vs. linear gas velocity in an individual fluidized bed.

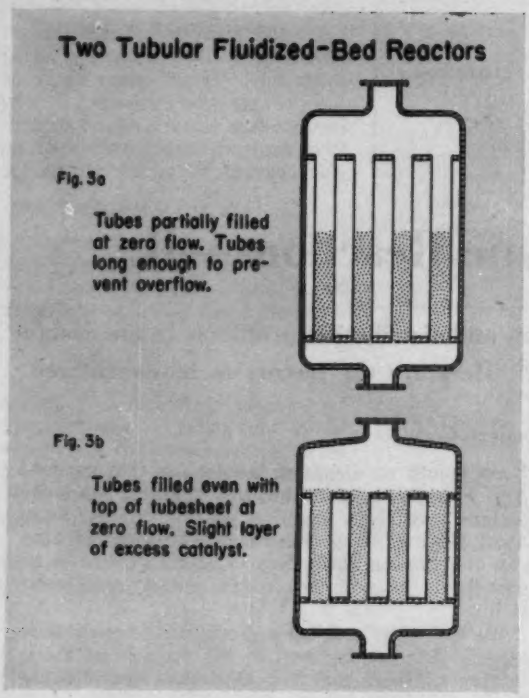
In Fig. 2 we present a picture story of what happens when the tube which contains the bed is long enough to prevent catalyst overflow. Fig. 2a shows the catalyst bed before gas flow starts. As the gas velocity increases, the pressure drop increases because of friction through the bed. But the force of the gas is not strong enough yet to lift the particles.

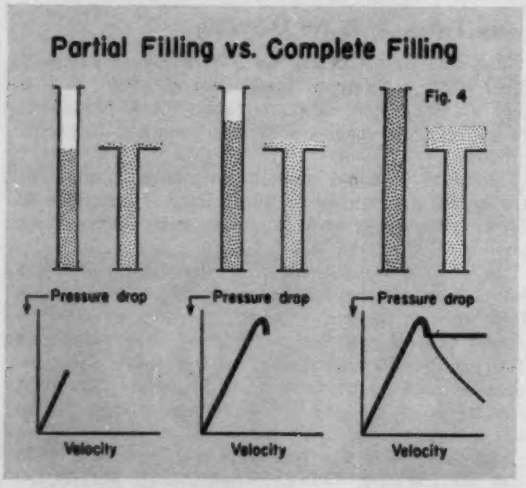
At this stage the bed is still a fixed bed with fine particle size. This is shown in Fig. 2b. As the gas velocity continues to increase we reach the point of "incipient fluidization" (see Fig. 2c). Here the particles are just beginning to be lifted and are in a slight state of agitation.

In the very first movement of the bed there is an initial inertia to overcome due to friction of the particles with the wall of the vessel and with each other. Therefore, a little more force is needed to start initial movement than for continued movement.

This is a very common phenomenon of physics. You probably have observed it in the simple experiment of pushing a block along a flat surface or a car out of a ditch.

After exerting the initial force to overcome


Two Tubular Fluidized-Bed Reactors
Fig. 3a
Tubes partially filled at zero flow. Tubes long enough to prevent overflow.
Fig. 3b
Tubes filled even with top of tubesheet at zero flow. Slight layer of excess catalyst.



inertia, slightly less force is needed to continue motion and there is a slight decrease in pressure drop. This is shown in Fig. 2c. From this point on the pressure drop due to the bed itself is equal to the weight of the fluidized particles.

As the velocity increases beyond this point in this type of bed there is only a slight increase in the pressure drop. This slight increase is due to friction of the gas with the sides of the tube (an effect that would be there even if the tube were empty) and friction of the particles with each other and with the tube wall.

These two forces are small compared to the weight of the catalyst in the usual operating velocities. Figs. 2d and 2e show how the pressure drop again increases slightly with velocity after the point of fluidization has been passed.

In the case that we just discussed and illustrated the same mass of catalyst remains in the tube as the gas velocity increases. This would be the case of a single tube reactor or of the nontubular fluidized-bed reactor illustrated last month (*Chem. Eng.*, April 1956, p. 200, Fig. 3).

Parallel-Tube Fluidized Reactors

There are two ways in which a parallel-tube fluidized-bed reactor can be operated. We have illustrated them in Figs. 3a and 3b. In Fig. 3a each tube is filled with the correct amount of catalyst and the tubes are long enough so that there is no significant loss of catalyst during operation.

This method of operation has its drawbacks, however. It requires longer tubes than are necessary for a given amount of catalyst, and the space in the upper portion of the tube is not utilized fully. Yet, even with excessively long tubes there will be—over a long operating period—a tendency for catalyst particles to be carried out of the tubes.

If this happens, the operation will become unstable in spite of the fact that long tubes are used. However, there is a precaution that can be taken to provide stable operation. Use completely filled tubes with a small reserve layer of catalyst on the top of the tube sheet.

And, if this precaution is taken, it renders the use of the excessively long tubes unnecessary anyway. This method of operation is shown schematically in Fig. 3b.

When You Use Filled Tubes

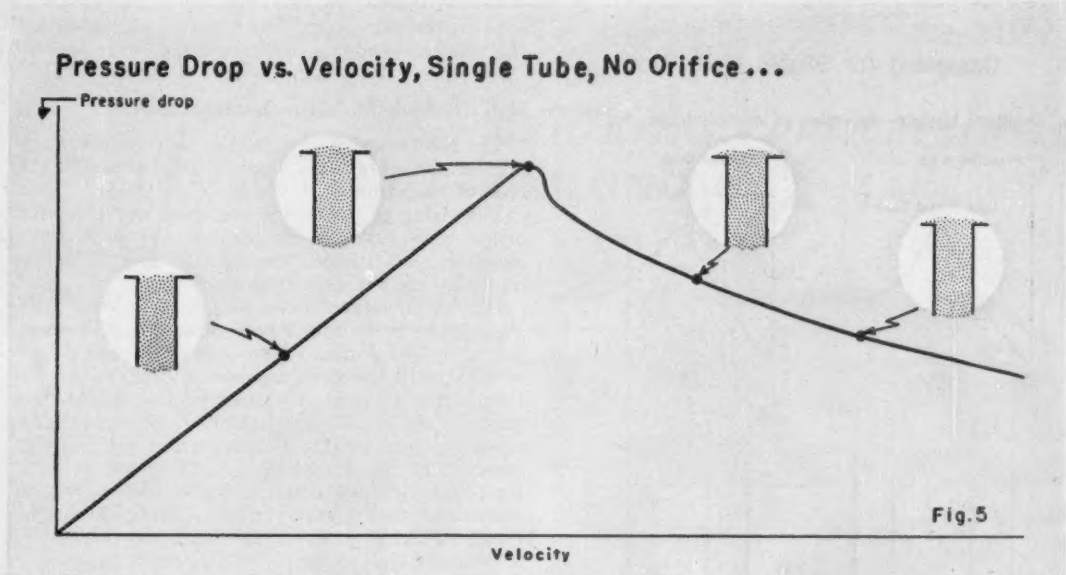
In the case of filled tubes, as described above, the main characteristic is that the mass of catalyst in any one of the tubes would vary with the velocity in that tube. This would be an inherently unstable operation if there were no means of keeping the flow through the tubes equalized. The flow is kept equalized by inserting a high pressure-drop orifice in each tube.

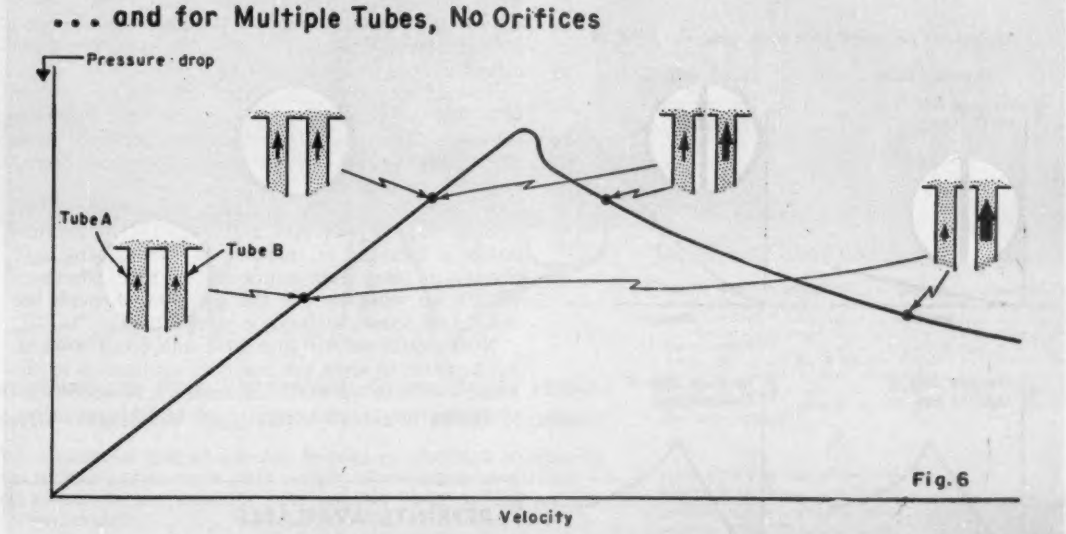
The exact size of the orifice is very important. Orifices should be sized precisely for a given set of operating conditions in order to provide for stable operation. Therefore, great care should be given to this part of the reactor design.

How Velocity Affects Pressure Drop

In this type of fluidized-bed reactor the pressure drop would first increase with velocity (as in the previous case) until the point of "incipient fluidization" is reached. There is the same break in the curve due to the inertia effect that we discussed above.

However, as velocity increases beyond this point, the pressure drop decreases. This is shown in Fig. 5. The reason for the decrease in pressure drop is this: Beyond the point of "incipient fluidization", the pressure drop is due mainly to the weight of the suspended bed.



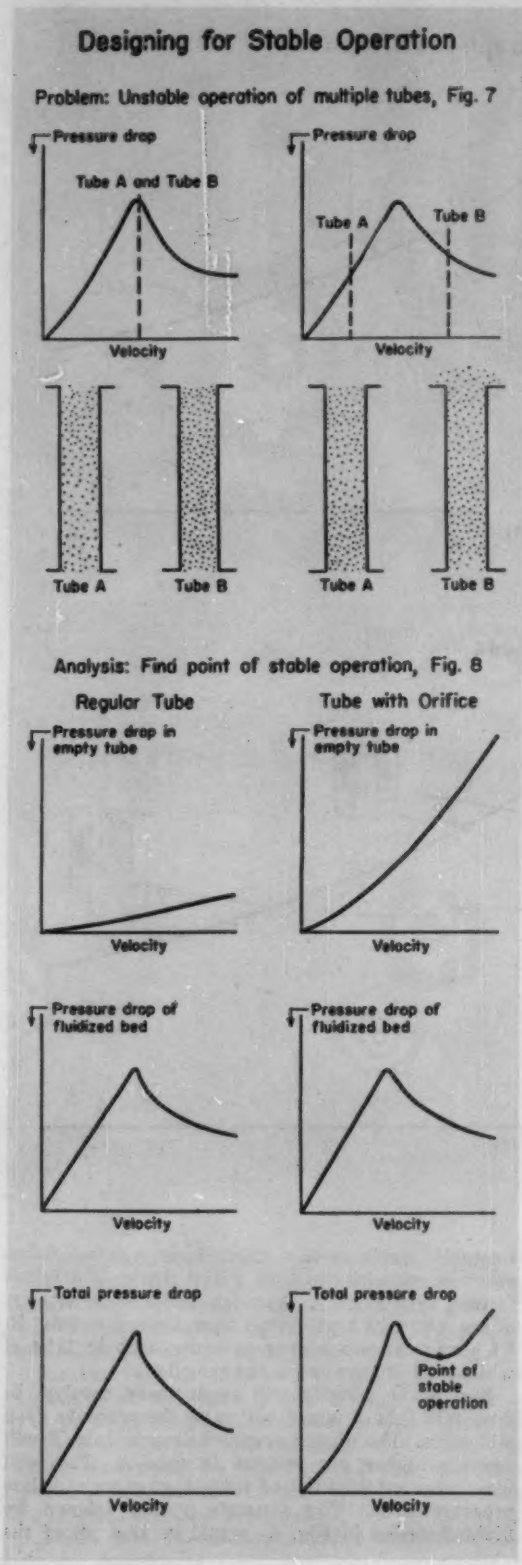


Therefore, in this type of operation the mass of catalyst in any single tube decreases as the velocity increases.

We can consider that the excess catalyst either joins the reserve of catalyst above the tube sheet or finds its way into another tube where the velocity may have reached a lower value. Fig. 4 shows a comparison of the behavior of two types of fluidized-reactor tubes. The behavior is the same up to the point of "incipient fluidization" but beyond that point the pressure drop decreases for the second type of reactor.

The flow for this type of reactor is basically unstable. Let's assume that there are two tubes starting out with the same initial charge of catalyst in each (see Fig. 6). Consider that a small amount of catalyst gets transferred from tube *A* to tube *B*. This will cause a higher pressure drop in tube *B* which will in turn lower the velocity.

The lower velocity will cause more catalyst to drop into tube *B* which will raise the pressure drop still more. The higher pressure drop in tube *B* will cause a higher gas velocity in tube *A*. This will blow more catalyst out of tube *A*, causing still less pressure drop. The ultimate result (shown by divided circles in Fig. 6) would be that all of the



gas would pass through half the tubes and all of the catalyst would pass through the other tubes.

How Orifices Stabilize the Operation

The reactor can be designed so that the operation will be stable. Insert a properly-sized orifice in the base of each tube.

The sizing of the orifice is critical and a specific orifice size must be determined for any given operating conditions. The specific size is determined by the pressure drop conditions.

Let us illustrate these design principles with Figs. 7 and 8. In Fig. 7 both tubes are shown first at the highest pressure drop (due to catalyst alone) possible with the same amount of catalyst in each tube. This is the most unstable point. Slight fluctuations can cause the situation at the right. Here the tubes have similar pressure drops but different amounts of catalyst. Fig. 8 plots ΔP vs. velocity for tubes with and without orifices. The pressure-drop effect in the empty tube is negligible in the range in which we are interested.

Consider that we're given the operating velocity for which we are designing the reactor. Fig. 8 shows the pressure drop due to the tube alone. Fig. 8 also shows the pressure drop through the catalyst when operated at the given velocity; and it also shows the pressure drop due to the tube plus the catalyst bed. This is the unstable condition described above.

Now if an orifice is put in the bottom of the tube, the pressure drop due to the tube plus the orifice is shown at the right; the pressure drop due to the bed alone, center right; and the total pressure drop at the bottom.

We can see that the pressure drop at the given design velocity will give stable operation because either a decrease or increase in gas velocity will give an increase in pressure drop. Therefore, there will be no tendency for the gas flow through the individual tubes to become unequal.

Next month we will present a completely-worked-out problem to show the practical application of the principles that we have discussed in these two installments on reactor design for catalytic reactions.

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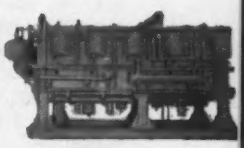
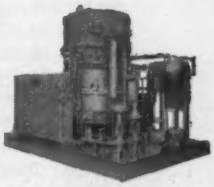


FLASH-TYPE EVAPORATOR—Combination of four (4) 50,000 gallons-per-day evaporators with a total distilled water capacity of 200,000 gallons per day. Unit will provide entire water supply for super carrier of the U.S.S. Forrestal class. Low-pressure steam is bled from propulsion turbines.



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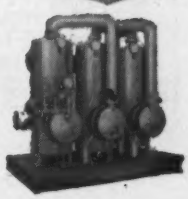

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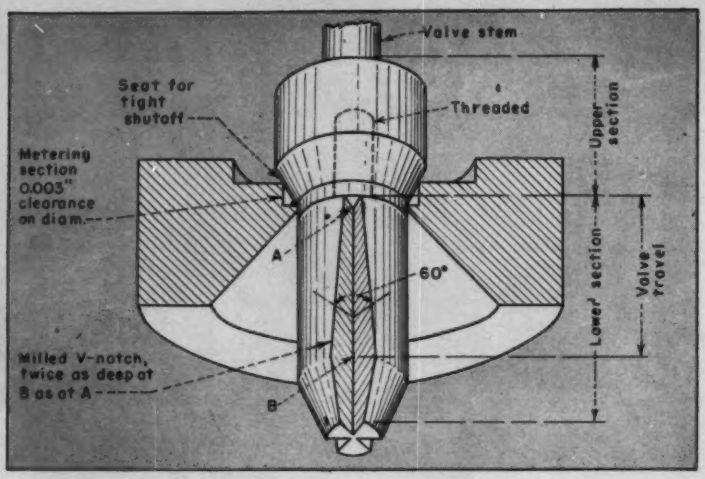

★ **Winner of February Contest**

Control Valves for Narrow Flow Range

Although you can purchase control valves with narrow flow range, making your own trim for standard valves costs less.

John T. Selldorff
Chemical Engineer, Denver, Colo.

Oftentimes very accurate control of a process stream is desirable in processes where the limits of the operating range are fairly narrow. However, conventional control valves usually have a rangeability (range from maximum to minimum flow) of 20:1. If the process flow is required to vary only by a factor of 1.5 or 2 during operation, then use of a conventional control valve results in operation over only a very small part of the total travel of the valve stem.

Such a situation makes for a "sensitive" valve in terms of controller output. The slightest change in operating air pressure results in an appreciable change in the flow of the process fluid. Particularly in the "manual" operation of the control valve is accurate control of the flow of process fluid difficult. Here we have what is known as a "touchy" or "tender" valve.

When faced with this problem we have found it convenient to make our own valve trim and install it in a standard single-seated, diaphragm-operated control valve.

The design of the trim is shown in the sketch above. We chose a fluted, single-seated type of plug for ease of fabrication, and also for tight shut-off. The size of the three flutes was calculated from the standard orifice formula and the hydraulic diameter of the opening. In water tests on the valves, we found that an orifice coefficient of 0.50 would correlate test data and predict flow values. The additional pressure loss represented by this low coefficient is probably due to the tortuous path that the fluid must follow in passing through the valve.

The rangeability as designed is about 4:1, which adequately covers the operating range and permits the controller sensitivity to be increased. Although most manufacturers can supply special trim, we found it realatively easy to make a suitable seat and plug in the maintenance shop when the occasion arises.

As the sketch shows, the plug is made in two pieces for ease of fabrication. The upper section is turned on a lathe, then the lower section is turned to size and milled with a 60° cutter. The depth of cut is twice as great at the lower end of the plug as at the upper. The lower section screws to the upper.

The smallest internal diameter of the seat has a clearance of 0.003 in. on the diameter over the plug, a compromise which insures the plug sliding easily in the seat, yet keeps

---

★ **Winner of March Contest—Victor Pratt**

"Bladder Valve" Seals Circular Ducts

How Readers Can Win . . .

$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering*, will award $50 cash each month to the author of the best short article received that month and accepted for the Plant Notebook.

Each month's winner will be announced in the issue of the second following month, and published the third following month.

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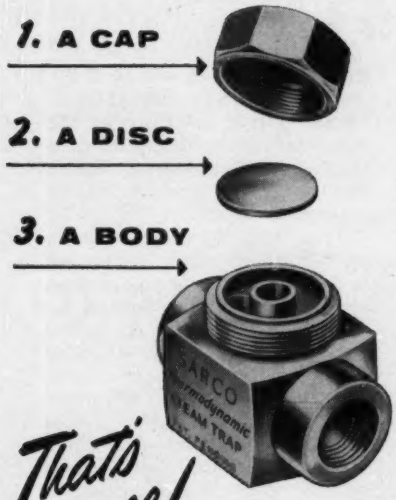
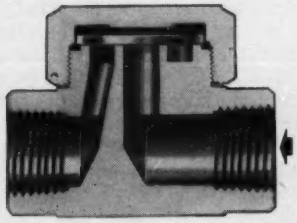


That's all!



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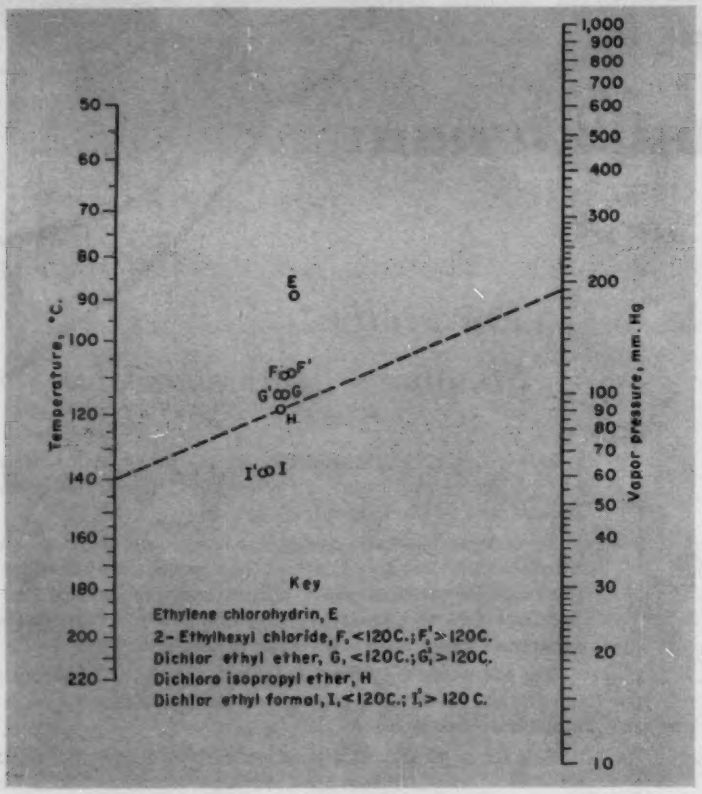
peripheral leakage to a minimum. The plug nose is tapered to act as a guide when the valve is assembled.

In the particular design shown the under side of the seat is cut away at 45°. With the liquid in question, it was expected there would be some vaporizing during passage through the valve. By permitting the vapor to expand into a relatively large space immediately after passing through the restricted section of the valve, the vapor is free to disengage sideways.

Thus the liquid does not undergo appreciable acceleration in passing through the valve, as would be the case if the liquid-vapor mixture were confined in a narrow channel immediately below the metering orifice. Back-pressure on the metering section is thus reduced, and steadier flow characteristics result.



Vapor Pressures of Chlorinated Solvents

Beecher J. Holland and D. S. Davis
Virginia Polytechnic Institute, Blacksburg, Va.

The accompanying line coordinate chart permits ready estimation of the vapor pressures of five industrially important solvents. It is based on data from "Organic Chlorine Compounds," published by Carbide and Carbon Chemicals Co. These have been correlated by means of the equation $\log p = A + B/(t + 200)$ where p = vapor pressure, millimeters of mercury, t = temperature, °C., and A and B depend upon the compound.

The broken index line shows that the vapor pressure of dichloro isopropyl ether is 190 mm. at 140 C.

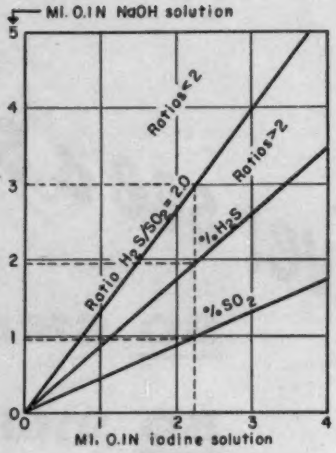


Chart Simplifies Control Of Sulfur Plants

Thomas Garcia B.* and Ismael Rodriguez L.
Respectively, Chief Chemist and Chief Safety Engineer, Petroleos Mexicanos, Poza Rica, Ver., Mexico.

In a sulfur plant such as ours, which uses the modified Claus process to produce elemental sulfur from H_2S, one-third of the H_2S is burned to SO_2, which then reacts with the unburned H_2S in another vessel to form sulfur and water vapor.

This being the case, the ratio of H_2S to SO_2 must be 2.0 for best plant efficiency and conversion. Control of the process depends on determining by analysis what this ratio is, and then adjusting to 2.0 if necessary. After making the titrations described below, the results can be entered into the chart above, which immediately shows whether the ratio is correct or whether the process needs adjustment, and in what direction.

The mixed gases are sampled and then reacted with 0.1N iodine solution in a 100 ml. (or a 500 ml.) Tutweiler burette. The excess iodine is back-titrated with 0.1N thiosulfate (both with starch indicator), and the resulting mixture of HI and H_2SO_4 is neutralized with 0.1N caustic soda, with methyl purple as an indicator. The equations are:

$$H_2S + 2I^- = 2HI + S$$

*Present address, Research Dept., Monsanto Chemical Co., Texas City, Texas.

J.B.–
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R.J.P.

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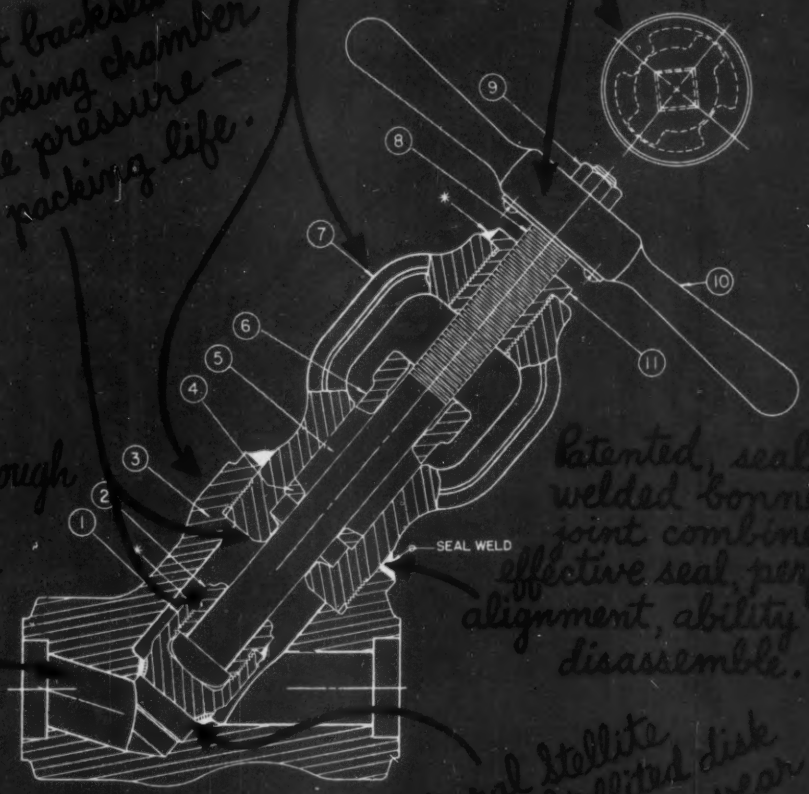

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PIECE NO.	NAME OF PIECE	NO. REQ'D.	MATERIAL	SPECIFICATIONS	EDWARD MS NO.
1	DISK	1	FORGED STEEL	A.S.T.M. A182 GRADE F11	227
2	DISK NUT	1	EVALLOY	A.S.T.M. A182 GRADE F6	212
3	BODY	1	FORGED ALLOY STEEL	A.S.T.M. A182 GRADE F11 (b)	227
				A.S.T.M. A182 GRADE F22 (c)	230
4	JUNK RING	1	STEEL-EVALIZED	A.I.S.I. C1120	123
5	PACKING RINGS		EVALPAK	HIGH TEMPERATURE PACKING	501
6	GLAND	1	FORGED STEEL	A.S.T.M. A105 GRADE II	111
7	BONNET	1	FORGED ALLOY STEEL	A.S.T.M. A182 GRADE F11 (b)	227
				A.S.T.M. A182 GRADE F22 (c)	230
8	STEM	1	EVALLOY	A.I.S.I. GRADE 416	261
9	STEM NUT	1	STEEL	A.S.T.M. A194 CLASS 1 OR 2	124
10	IMPACTOR HANDLE	1	MALLEABLE IRON	A.S.T.M. A47 GRADE 32510	322
11	YOKE BUSHING	1	BRONZE	A.S.T.M. B148 GRADE 9B HT	432
12	GLAND BOLT NUT	2	STEEL	A.S.T.M. A194 CLASS 1 OR 2	124
13	GLAND STUD	2	STEEL	A.S.T.M. A193 GRADE B7	208
14	GLAND BOLT LOCKNUTS	4	STEEL	A.S.T.M. A194 CLASS 1 OR 2	124

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GENERAL ASSEMBLY
FIG.-3924 SIZES ½, ¾, 1, 1¼, 1½, 2

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$H_2S + 2I^- = 2HI + S$
$SO_2 + 2H_2O + 2I^- = 2HI + H_2SO_4$
$HI + H_2SO_4 + 3NaOH = NaI + Na_2SO_4 + 3H_2O$

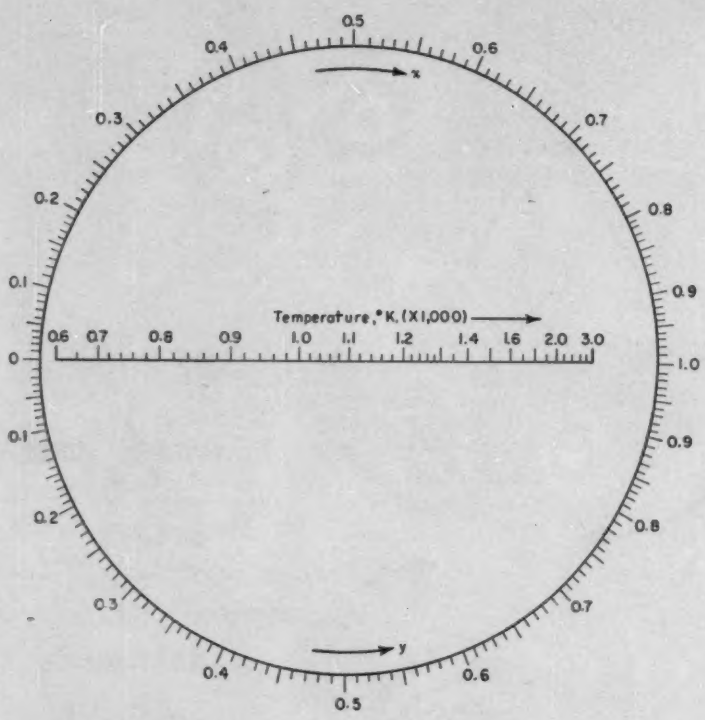
If a is the ml. of 0.1N iodine used and b is the ml. of 0.1N NaOH used, then, according to these reactions, $H_2S/SO_2 = (2a—b)/(b—a)$. If we use a 100 ml. Tutweiler burette at 35 C., then

$\% H_2S + \% SO_2 = a \times 1.31$

and

$$\% SO_2 = \frac{(\% H_2S + \% SO_2)}{(H_2S/SO_2) + 1)}$$

The chart is constructed from these relations. As an example, if 2.25 ml. 0.1N iodine solution was used, plus 3.0 ml. of 0.1N NaOH solution to neutralize, then entering the chart at these respective points from the bottom and left shows the intersection to fall on the line for $H_2S/SO_2 = 2.0$. If the intersection had fallen above the line, the ratio would have been low, requiring plant adjustment (less air) to produce less SO_2. Conversely, if it had fallen below the line, adjustment would be required in the opposite direction. The chart also shows the percentages of the two gases present. Similar charts can easily be constructed for 500 ml. burettes, or for temperatures other than 35 C.



Gas Composition in Rich Combustions

Norbert W. Luft
Cheadle Hulme, Cheshire, England.

With excess air and complete combustion in systems containing carbon, hydrogen, oxygen and nitrogen, the only combustion products formed are CO_2, H_2O, N_2 and O_2. Their concentrations are determined simply by the elemental material balances. However, with rich mixtures, the products include CO_2, CO, H_2O, H_2 and N_2, provided there is enough oxygen to suppress deposition of solid carbon. Such systems are of great practical interest in production of synthesis gas and the combustion of organic fuels near and below 2,000 K.

If we write the combustion equation for 1 gram-atom of carbon in the fuel as;

$CH_aO_bN_c = (CO_2 \text{ or } CO) + (a/2)\ (H_2O \text{ or } H_2) + (c/2)\ N_2$

Where a, b and c are respectively the number of atoms of H, O and N, then we have the mass balances ($\Sigma n_i = 1 + a/2 + c/2$):

$$1 = n_{CO_2} + n_{CO}$$
$$a = 2n_{H_2O} + 2n_{H_2}$$
$$b = 2n_{CO_2} + n_{CO} + n_{H_2O}$$
$$c = 2n_{N_2}$$

where n_i is the number of moles of the i-th species, per gram-atom of carbon. The last equation shows that nitrogen acts merely as a diluent. The concentration of the other four constituents of the combustion gas is determined by the first three equations and the equilibrium constant:

$$K = n_{CO_2} n_{H_2} / n_{CO} n_{H_2O}$$

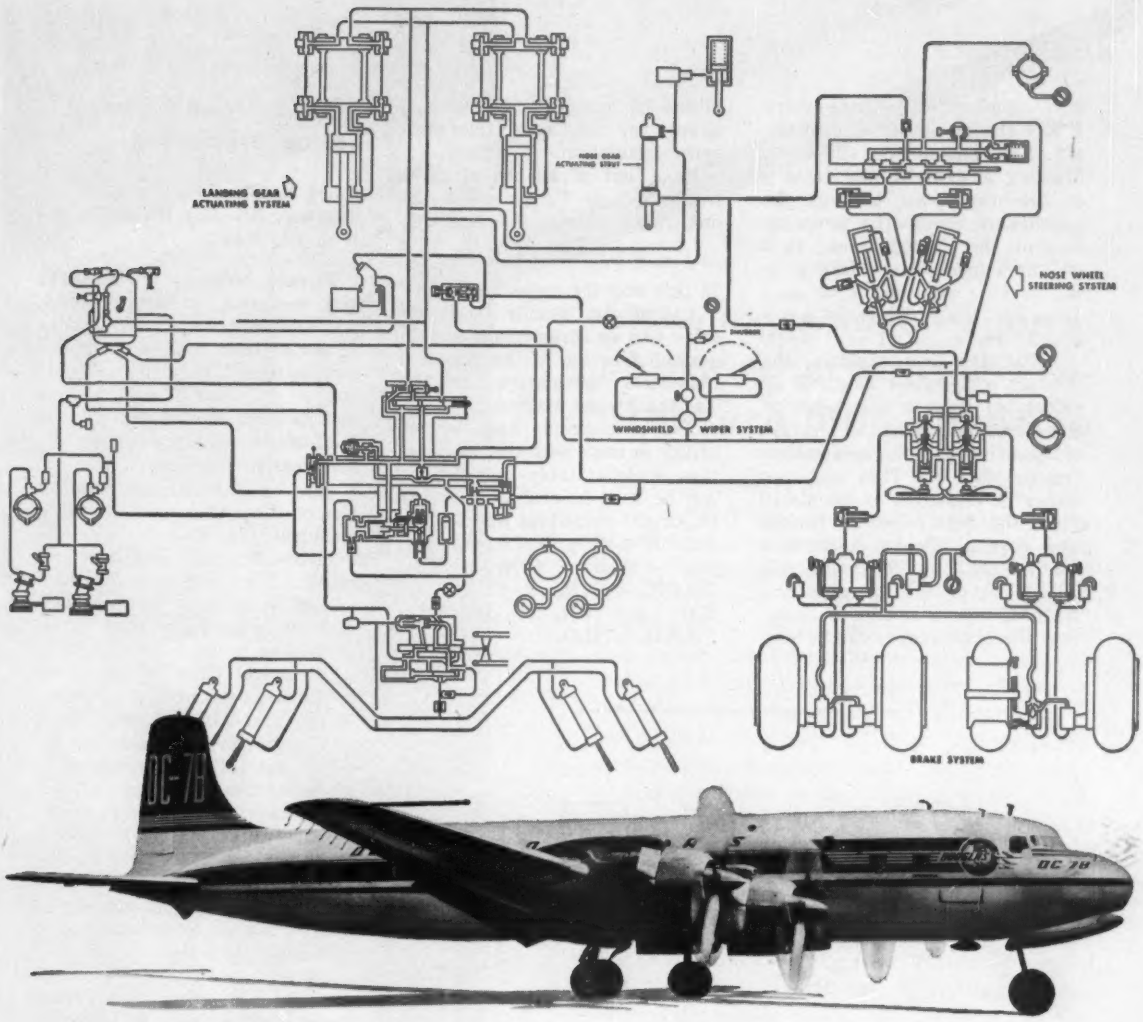
of the water-gas equilibrium. Values of K have been tabulated by the National (U. S.) Bureau of Standards in "Selected Values of Thermodynamic Properties," III, 1946-49.

Although the relations discussed apply at combustion temperatures below 2,000 K., even when using pure oxygen and temperatures much above 2,000 K. (when dissociation of the constituents become significant), consideration of the water-gas equilibrium and the above products still provides a useful first approximation for the region of oxygen shortage, i.e.,

$$\lambda \equiv b/(2 + a/2) < 1.0$$

It is therefore useful to have a quick method for evaluating the product concentrations of this important system.

Sometimes the CO_2 concentration (i.e., n_{CO_2} or the number of moles of CO_2 per gram-mole of fuel carbon) can be had from the chemical analysis of the combustion gas. Then the concentrations of the other products (at



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any combustion temperature T°K.) can be obtained with the aid of the nomograph, simply by drawing a straight line from y on the lower scale, through the appropriate combustion temperature on the straight scale, to x on the upper scale. Here $y = n_{CO} = 1 - n_{CO_2}$, and $x = n_{H_2O}/(n_{H_2O} + n_{H_2})$. Thus, $n_{H_2O} = x(a/2)$ and $n_{H_2} = (1 - x)(a/2)$.

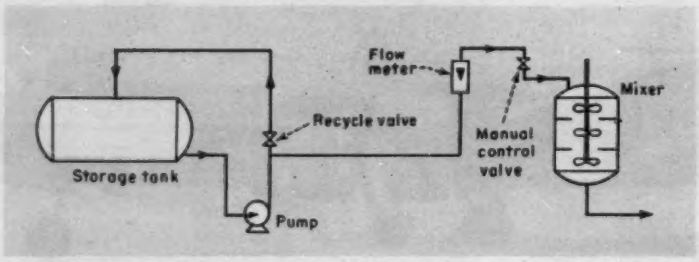
Without a gas analysis, the product composition can still be calculated from a knowledge of the elemental unburned mixture composition and the combustion temperature T. This last can either be measured or calculated from the heat balance. Tanaka and Awano (Repts. Aero. Res. Inst., Imp. Univ., Tokyo, 2, 493, 1933) developed a graphical method, but it is time consuming. Their procedure can be simplified by using the nomograph above for an easy trial-and-error calculation.

Here, out of all the straight lines through T, we select the one which satisfies the condition

$$y = (a/2)x - (b - 2)$$

In this way the correct values of x and y can usually be found after two or three trials, and in a small fraction of the time for numerical calculation or the Tanaka-Awano method.

The nomograph has further utility in that, with the temperature scale suitably modified, it can be used in evaluating other important equilibria of the type $A + B = C + D$, for example: $CO_2 + H_2S = COS + H_2O$; $CH_3OH + NH_3 = CH_3NH_2 + H_2O$; and $CH_4 + HNO_3 = CH_3NO_2 + H_2O$.



How to Cut Centrifugal Pump Delivery

David Wittenberg
Engineer, Kiryat Motzkin, Haifa, Israel.

In building a pilot plant for a process which was later to be expanded to plant scale, we had the problem of delivering two liquid reactants to a continuous mixer at flow rates of 0.1 and 0.25 gpm. against 100 ft. head. Since we were unable to obtain pumps of such small capacities, we decided to order centrifugal pumps of 12 and 30 gpm. capacity which could later be used in the finished plant.

We thought it might be possible to throttle these pumps down to the desired delivery rates, but when it was tried we found that they heated up considerably. Furthermore, we believed that the use of a bypass between the discharge and the suction connections would make matters worse.

The solution to the problem is indicated in the sketch. Each pump was connected back to the supply tank, with a branch line leading through a flow meter to the continuous mixer. Each system requires two hand-operated valves for regulation, in this instance being of the diaphragm type. The valve in the recycle line is throttled a little to insure flow through the branch, after which delivery to the mixer is set by means of the second valve and the flow meter.

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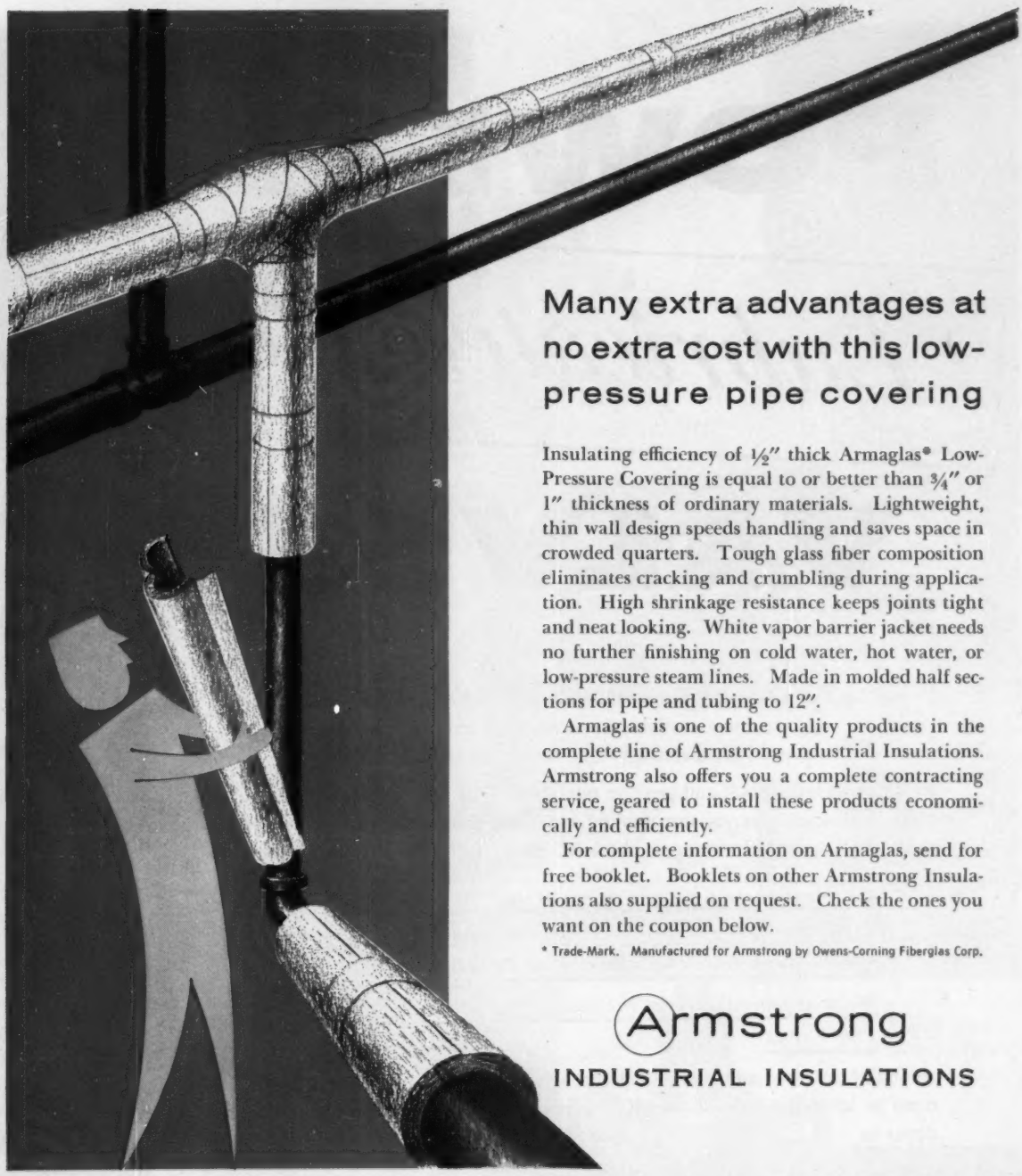
A typical class of these cements consists of the polymers of furfural with ketones. These are particularly suitable for dimensional linings, the covering of defects, sealing, and the like. Often they can replace more expensive lining materials such as lead, babbitt and fiber, for example, in the lining of grinding wheel holes. Such linings can be applied readily by means of suitable plugs and dies.

In mixing the cement at the time of use, the liquid furane resin is mixed with an acid-containing powder to make a room-temperature-setting material. The ratio is about two parts of powder by weight to one of liquid resin. For the powder it is usually practical to use 360-mesh silica, which is available on the market at 3 c. per pound. The acid catalyst may be p-toluenesulfonic acid technical powder; or oxalic acid if the resin is of the furfuryl alcohol type.

Reducing the amount of acid in the filler slows setting and gives a rather long pot life, but sometimes this makes it necessary to hasten the hardening with infrared lamps. Adhesion can be improved by using high-viscosity resins, e.g., 300 centipoises. If it is desired to reduce stringiness, a thinner resin can be used, or certain additives such as silica aerogel (Santocel) may give the mixture the desired consistency.



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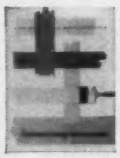

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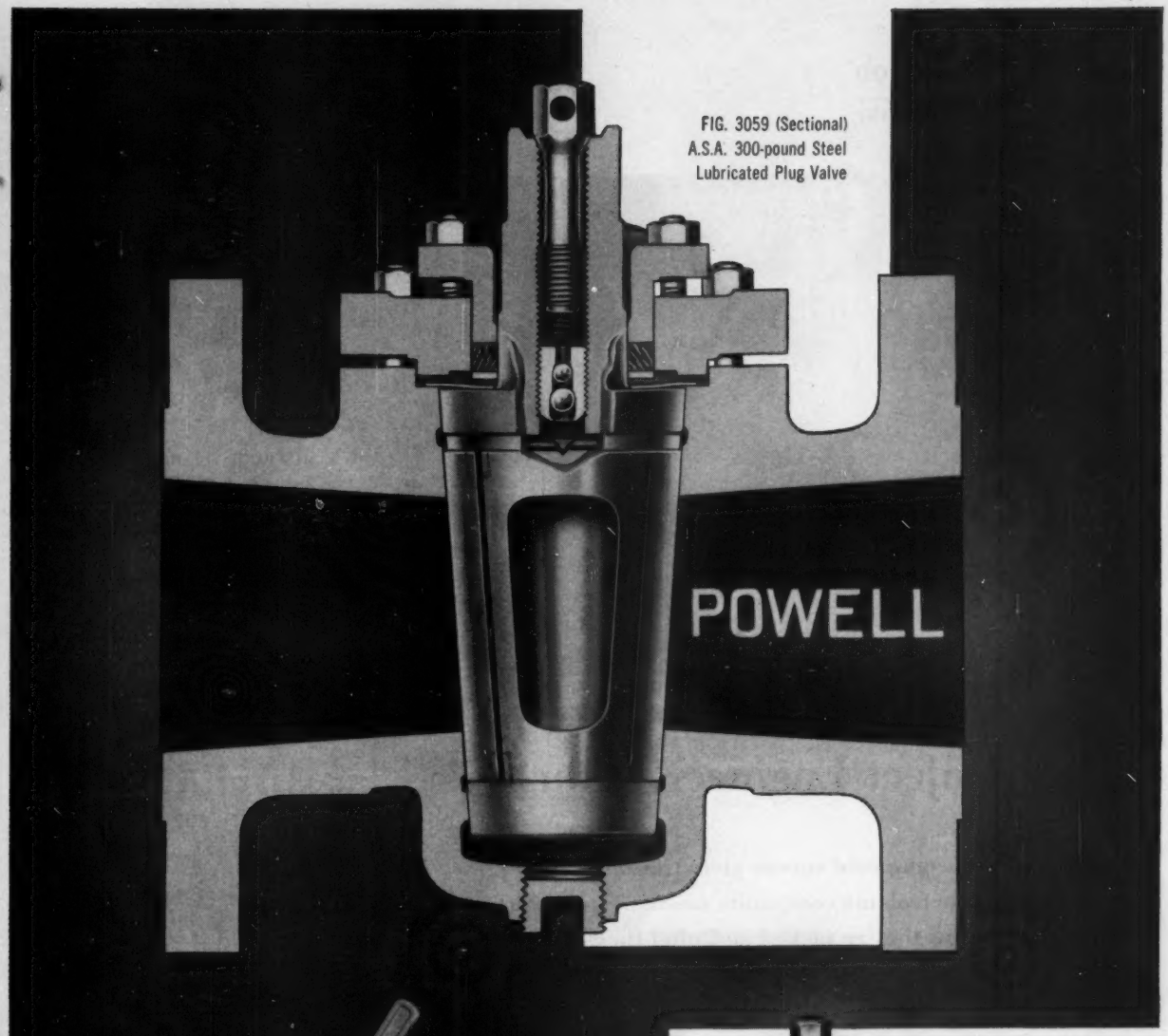

FIG. 3059 (Sectional)
A.S.A. 300-pound Steel
Lubricated Plug Valve

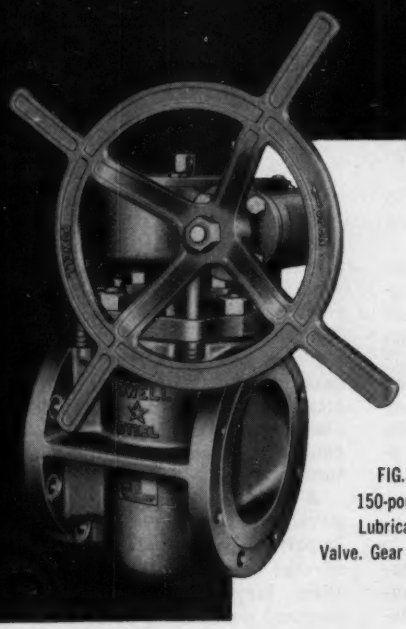

FIG. 1559G—
150-pound Steel
Lubricated Plug
Valve. Gear operated

FIG. 2200—175-pound W.O.G.
Semi-Steel Lubricated Plug Valve

◂Who is he?

◂What does he do?

◂How is he trained?

◂What skills does he need?

◂How does he do his job?

◂Who hires him?

◂How much is he paid?

The Project Engineer: Industry's Plant Builder

A just-completed survey gives the answers on how chemical and petroleum companies use their process engineers. Also how they're picked and what they're paid.

Carl W. Barkow, Univ. of Tennessee

The typical project engineer in the chemical and petroleum industries is a chemical or mechanical engineer in his late thirties. He probably has a background of about 5-10 years in design or construction work. And he now earns near $10,000 per year.

This portrait emerges from a just-completed survey of chemical and oil companies. Primary aim of this study was to learn how these firms use project engineers to organize and direct company expansions from their authorized inception to completion.

Some 232 questionnaires were sent to those companies in the industries that are apt to include an engineering division—responsible for the design and construction of new plants and major alterations and major repair jobs on existing facilities—in their organization. About 95 of the 117 replies contain enough information to be usable.

While a good many companies do not list a project engineering group as such and may even call the men who head up their building groups project managers or job engineers or construction managers or any of a handful of other names, the concept is essentially the same and for purposes of the survey all are grouped as project engineers.

CARL W. BARKOW *made the study he describes here as his thesis project at the University of Tennessee, where he is a candidate for an M.S. in Business Administration.*

Handle a Big Job

In about 65% of the answering companies, the project engineer takes complete responsibility for administering the building program from authorization to completion. Generally, his prime responsibilities include planning, scheduling and coordinating the design, purchase and construction of plant units.

So important is his function that he reports directly to either the company president or to a vice president in nearly four out of five reporting firms.

Carefully Chosen

Since it is such an important job, companies say that they're pretty careful in picking men to be project engineers. Generally, they look for a 30 to 40-year-old chemical or mechanical engineer. Both his work background and personal qualities—particularly personal and professional integrity and the ability to make decisions and stand behind them—rank high among selection factors.

A high scholastic standing or advanced degrees are considered important by only about a third of the respondents, many of them large (over 5,000 employees) companies. Most of the

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features of GATX aluminum tank cars*

*Flued Dome Construction*** • *All-Welded Tank, Jacket and Underframe* *Corner Posts and Girth Bands Riveted to Underframe* • *Safety Dome Platform (Available)* • *Insulation (Available)* • *One-Piece Longitudinal Bottom Plate* • **All features standard unless otherwise indicated.*

**The one-piece flued dome saddle was designed and pioneered by General American as early as 1938.

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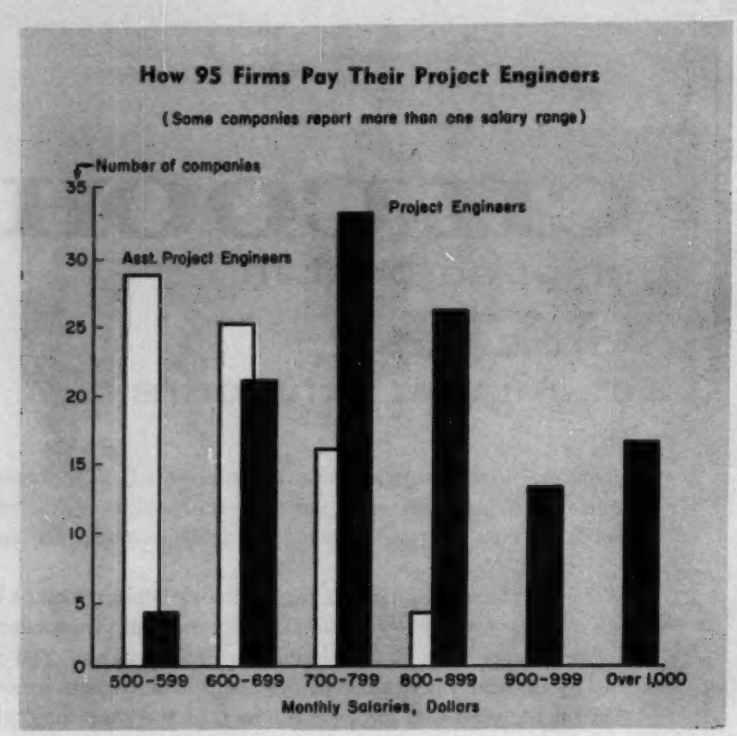

other firms attach relatively little importance to this factor.

On the other hand, some 65 firms consider the branch of engineering the man studied as important in making their choice. Chemical and mechanical engineers, in roughly equal demand, predominate.

Age and Experience Count

Along with integrity and decision-making ability, companies give experience the greatest weight in choosing a project engineer. Only eight firms answered negatively when asked if previous industrial experience is necessary for a project engineer.

What kind of experience is best? Answering companies rank design, construction and maintenance at the top of the list, and in that order. Research and development work they put at the bottom.

Length of this experience is also important. Only one company out of ten will place an engineer in charge of a project with less than five years of industrial experience. Of the survey respondents, over 20% require at least six years, 19% want 10 years and 13% cite 11 to 15 years as the minimum experience needed.

To find the proper combination of experience, maturity of outlook and physical vigor needed to direct an engineering project, many companies consider age a vital factor in selecting their project engineers. Overwhelmingly, they believe that 30 to 40 is the most desirable age range.

Little Training Given

The extreme care which these firms take in picking a project engineer is understandable since they apparently believe that project engineers are born, not made.

Only about a third of the respondents claim to give any training which would fit men for these jobs. And less than 40% of these give such training *before* the man moves into the position.

With those that do train, individual coaching and use of "assistant to" posts are the means used most often—although a few firms conduct more formal courses or seminars. Usually the instruction given centers around project planning and organizing, with human relations and budget controls also popular subjects.

As might be expected, firms with over 1,000 employees are much more likely to run training programs.

Salaries Are Relatively Good

Once a man is named as project engineer he can expect to do fairly well salarywise.

Median earnings of those with five years experience is $8,460. It climbs to $9,500 for those with 10 years experience and to $10,570 for men with 15 or more years. Those with the large companies are apt to make a little more than their small company counterparts.

Many of the respondents also reported the rates paid to assistant project engineers. Median for this group is $7,740.

It isn't possible to determine the effect of the amount of responsibility given a project engineer on his salary from the results of this survey. But the fact that 13 of the 16 companies that reported monthly salaries of over $1,000 also gave the project engineer complete charge of the project does suggest a relationship.

Setting Limits on Them

But not all firms give their project engineers such complete responsibility. Some 40% say that their men are limited in one way or another. Company size appears to have no effect on this.

In addition, many of the firms which say that their project engineers have complete charge of all operations put purchasing in the hands of another group. Most firms define his responsibilities as supervision of design and construction, but about 30% of those surveyed limit him to either design or construction. Some firms place even greater restrictions on their project engineers, giving them authority over only a "few" phases of the project. These phases vary, but they generally involve design and construction.

In addition to organizational

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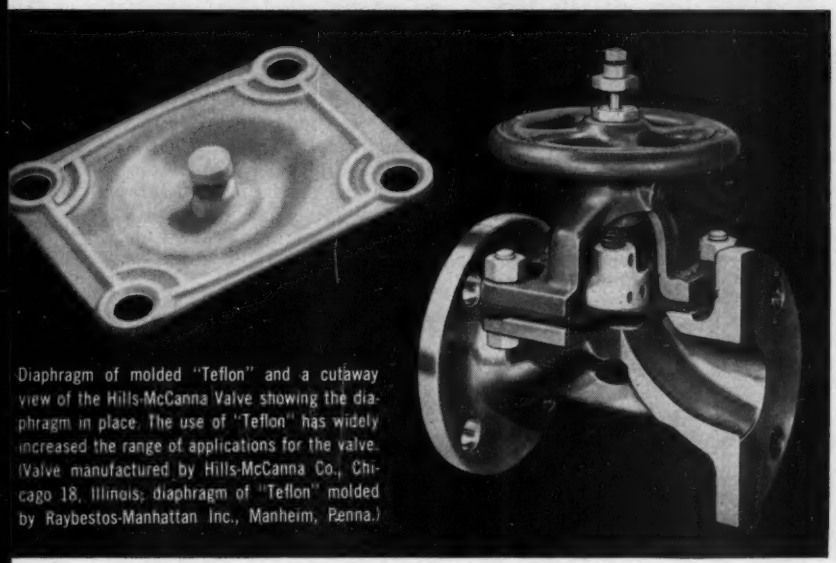
CHEMICAL ENGINEERING NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

Diaphragms of Du Pont TEFLON® enable valves to meet new performance standards



Diaphragm of molded "Teflon" and a cutaway view of the Hills-McCanna Valve showing the diaphragm in place. The use of "Teflon" has widely increased the range of applications for the valve. (Valve manufactured by Hills-McCanna Co., Chicago 18, Illinois; diaphragm of "Teflon" molded by Raybestos-Manhattan Inc., Manheim, Penna.)

The physical and chemical characteristics of Du Pont's "Teflon" tetrafluoroethylene resin have made possible the valving of many extremely hard to handle fluids. As a diaphragm in the Hills-McCanna valve shown at the left, "Teflon" will handle temperatures up to 400°F., pressures to 100 psi. These characteristics coupled with the remarkable chemical inertness of "Teflon" result in a valve suited to a wide range of operating conditions ... a valve that can be satisfactorily used for any concentration of mineral or organic acids, alkalies, chlorinated industrial solvents and many other corrosive fluids.

The chemical inertness, heat resistance, resiliency and toughness of "Teflon" recommend its use in gaskets, packings, and component parts of pumps, agitators, mixers, etc. In many applications in the chemical processing industry, "Teflon" is the only material that can be used successfully over any period of time. Since it is unaffected by corrosives, the use of "Teflon" greatly enlarges the range of materials a given piece of equipment can safely handle ... reduces maintenance costs and downtime, and often permits simplification of design. Complete property and application data on this versatile Du Pont engineering material is available. Mail coupon below.

⅛" lining of ALATHON® protects chemical fume system

"Alathon" polyethylene resin offers many properties of interest to the chemical processing industry. It resists most common chemicals, is light in weight yet strong and flexible, can be readily heat-welded, and is available in the forms of film, sheet, tubing, pipe or molded products.

A typical use of "Alathon" is shown at the right. Here ⅛" sheets of this versatile material are being used to provide a corrosion-resistant lining for a chemical fume system. The sheets are riveted in place and all rivet heads are covered with discs of "Alathon" to protect these heads from corrosion. All seams are heat-welded with butt strap reinforcing. The spark-testing operation shown is a convenient method for checking the quality of the seals. (Lining of "Alathon" manufactured by American Agile Corporation, Bedford, Ohio.)

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Room 255 Du Pont Building, Wilmington 98, Delaware
In Canada: Du Pont Company of Canada Limited, P.O. Box 660, Montreal, Quebec

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limitations, the project engineer invariably works under very strict budget restrictions. In the companies surveyed the most popular methods of controlling deviations from the budget involve:

- Allowance of a fixed percentage, or a fixed dollar amount, of the total authorized for overruns or under runs.
- Justification to management of all costs which do not stay within estimate.
- Approval of management before exceeding amount authorized.

How They Work

Assembling and integrating the many elements of the construction project demands considerable managerial skill. And project engineers approach their jobs in a variety of ways, depending on company organization and policies and their own attitudes and training.

Preparation of workable, complete time schedule for all facets of the job is a major part of his work. Therefore the first part of the project engineer's job involves the preparation of estimates.

Only about 20% of the firms surveyed give him the final say in defining the scope of the project—although his advice may be sought and he may participate in these decisions. Usually the project engineer is assigned to the project after its broader outlines have been set. He then determines what is physically required for the project, the erected cost and the operating costs of the new facility.

Working from these estimates, management makes its decisions on whether or not to proceed and how much to authorize for the project. If the choice is yes, the job moves back to the engineer.

The project engineer can base much of his remaining work on carefully done preliminary studies. Together with process information and site information these estimates are the basis for the job schedule. This sets the time to be spent on each portion of the job by each of the many groups involved. It tells the engineer how many men will be required for each phase and what skills they should have.

Then the project engineer's job becomes the coordination and supervision of these men and skills. His prime tools in achieving this include periodic progress reports, schedules for each section of the work, budget review meetings and company and job standards.

Typically, the job of the project engineer ends only after the new facility goes onstream. Generally, he still remains in charge through the start up procedure and quite often developing this procedure is one of the tasks in his charge.

* For more on the work of the project engineer see *Chem. Eng.*, Mar. 1950, p. 125.

TECHNICIANS

. . . *Two Per Engineer*

How many technicians or engineering aides should your company use? A number of authorities say about two for every engineer.

How many technicians does your firm actually have? If it's like the 18 oil and chemical companies questioned in a recent survey, it has about 0.9 technicians for each chemical engineer.

A few process industry firms do employ the recommended ratio of two to one. But many fail to back up their engineers with even a handful of sub-professional help.

One of the major reasons for this lack is the shortage of adequately trained sub-professional men and women. This year the nation's technical institutes will graduate an estimated 14,000 technicians—about 60% of expected total of engineering grads. And may of these will have studied specialties which have only limited use in the process industries.

Silver lining to this dark cloud is the fast-rise in enrollments of technical institutes. In 1955 about 70 of these schools had 26,766 full-time students on their rolls, up 24.3% from the year before. And many firms are supplementing this supply by enlarging their training programs for high school graduates.

Another obstacle to wider use of aides and technicians is the lack of understanding of their capabilities and limitations. Some engineers can use up to half a dozen technicians effectively, but many others can't keep one busy properly. Often this is because the engineer works best by himself. However, in too many cases it's because the engineer doesn't know how to supervise or delegate responsibility to the technicians assigned to him.

What can these engineering aides do best to help the engineer? Experience has shown that in making computations with mechanical calculators, running laboratory and pilot plant equipment, testing and inspecting the well-trained technician will do just as good a job as the engineer.

—*The Wall Street Journal*

Next Month: What the New Graduates Know

To use 1956's crop of chemical engineering graduates to your best advantage you have to know what you're starting with. Chemical engineering education is always changing. New trends develop, older ones flower—or die. In any event, the newly-minted engineer is apt to have been exposed to course material much different than you remember. To help these newcomers take their places with a minimum of lost motion, to use them to their full capabilities or simply to bring yourself up-to-date on chemical engineering education, circa 1956, next month's You and Your Job will report on the new graduates and what they've learned.

it won't be long now!

National's Major Plant for large scale production of Aromatic Diisocyanates

NACCONATES*

Nearing Completion at Moundsville, W. Va.

Soon—very soon—polyurethan producers can proceed "full speed ahead"—assured of ample domestic output of NACCONATES (aromatic diisocyanates) for immediate commercial needs.

Our new multi-million dollar NACCONATES plant will multiply available diisocyanate supply many fold. It will help polyurethans to achieve their destiny as "America's next great synthetic".

Pending shakedown of these new facilities, National offers very practical help on polyurethan projects:

- Commercial quantities of NACCONATES from our Buffalo plant for market development work.
- The first comprehensive "product-data package" of six NACCONATES Technical Bulletins, jam-packed with basic technical information on our long line of diisocyanates.
- Field Technical Service on your polyurethan production problems.

We invite you to use these helps to the limit. In view of our desire to handle requests in the order of their urgency, we ask that you fill out the coupon completely and attach it to your letterhead.

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ALLIED CHEMICAL & DYE CORPORATION
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I am ☐ now working with diisocyanates; ☐ working in areas where they may be used; ☐ broadly interested in background data.

☐ *Please send me* NACCONATES *Product Data Package—6 technical bulletins on diisocyanates.*

☐ *Have representative call by appointment.*

Name: _____

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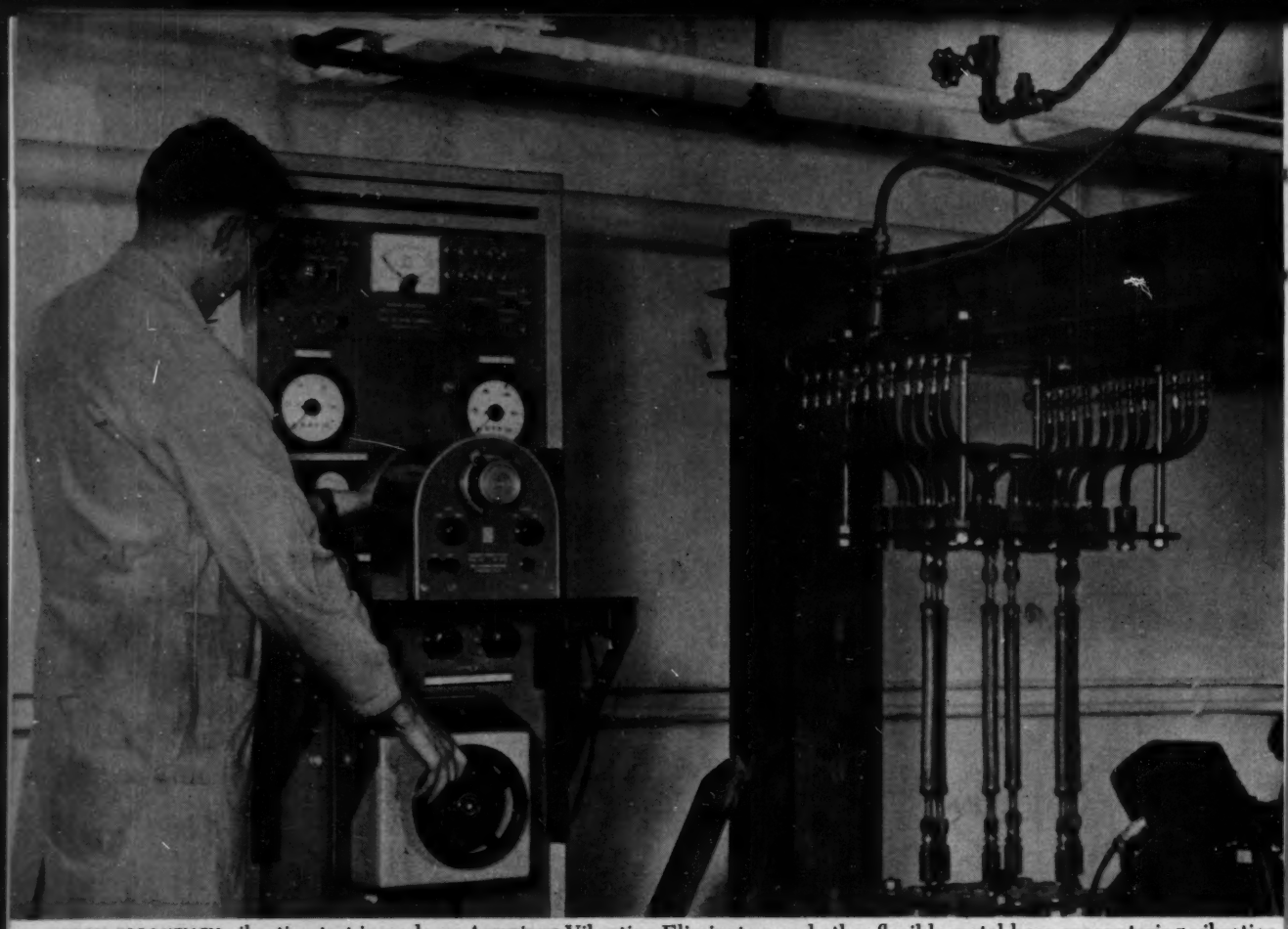

HIGH FREQUENCY vibration test is made on American Vibration Eliminators and other flexible metal hose encountering vibration.

Here's why American flexible metal hose gives you more service hours per dollar

When you buy flexible metal hose, you are really buying "service." And the lowest bid is not necessarily the greatest bargain.

For customers tell us American metal hose consistently outperforms any other make . . . delivers *more service hours per dollar!* From raw material through finished assembly, American Flexible Metal Hose and Tubing undergoes continuous inspection and checking for conformance to the *highest and most rigid standards* in the industry.

FAST SERVICE

American, too, offers you fast, sure service on standard metal hose in brass, bronze, aluminum, steel and stainless steel in a wide range of sizes. End fittings are available for all types of connections. Many packaged items carried in stock.

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Our design service—proved on thousands of jobs—is ready to help you with your problem at no extra charge. Check with American first when you plan a new installation or want to improve unsatisfactory connections—you'll save time and money. Phone, wire or write! The American Brass Company, American Metal Hose Division, Waterbury 20, Conn. Offices in major cities. In Canada: The Canadian Fairbanks-Morse Company, Ltd.

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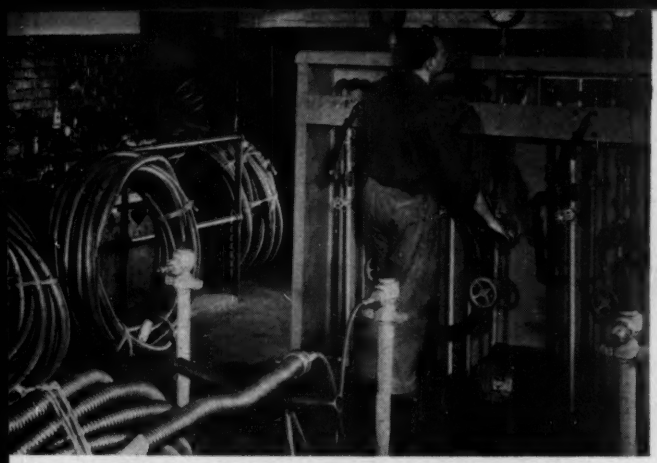
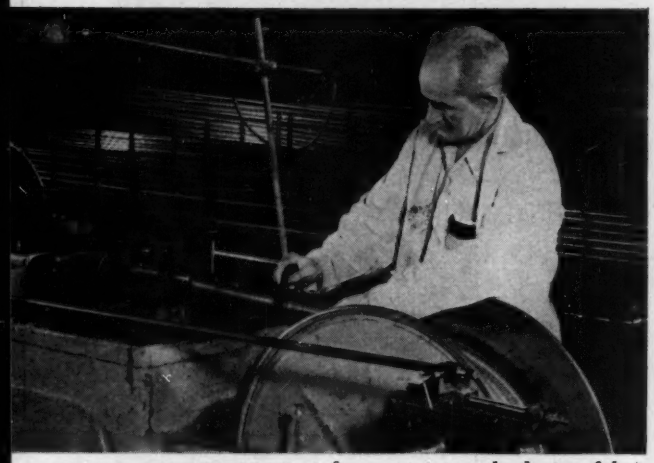
WHEREVER CONNECTORS MUST MOVE

AMERICAN flexible metal hose and tubing

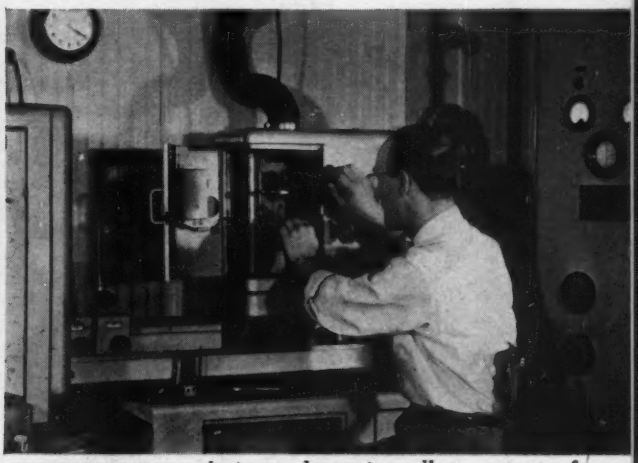


HYDROSTATIC, air or steam test is given all assemblies specifying pressure tightness. Test assures units absolutely free of leaks.

CONTINUOUS FLEXURE testing is conducted to be certain that the longest life is "built into" American Metal Hose Assemblies.



ON THE JOB INSPECTION at frequent intervals during fabrication assures rigid compliance with customers' specifications.



SPECTROGRAPHIC analysis to determine alloy content of metal is typical of American's program to assure that finished assemblies are "right"–from the start.

MICROSCOPIC EXAMINATION of sections of raw materials determines if such factors as grain structure meet required quality standards.

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THE AMERICAN BRASS COMPANY
American Metal Hose Division,
Waterbury 20, Conn.

Please send me your free Quick Reference Catalog CC-400 containing basic information on all types of metal hose and tubing, fittings, etc.

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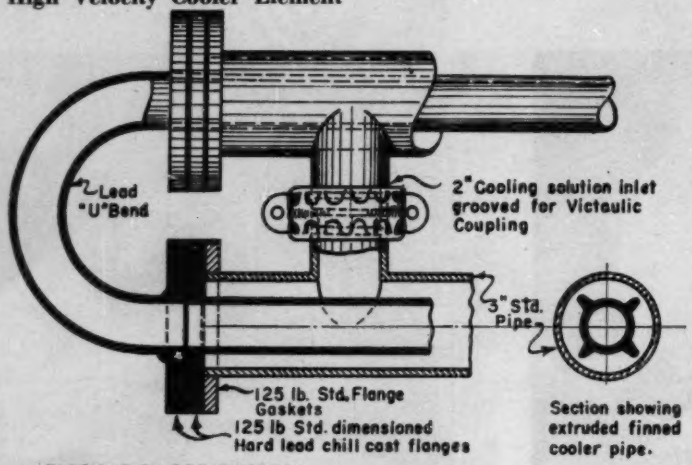
Best Designs for Lead Installations

Recommended practice for the fabrication of high-velocity coolers, homogeneous lead linings, and lead specialties for use with corrosives.

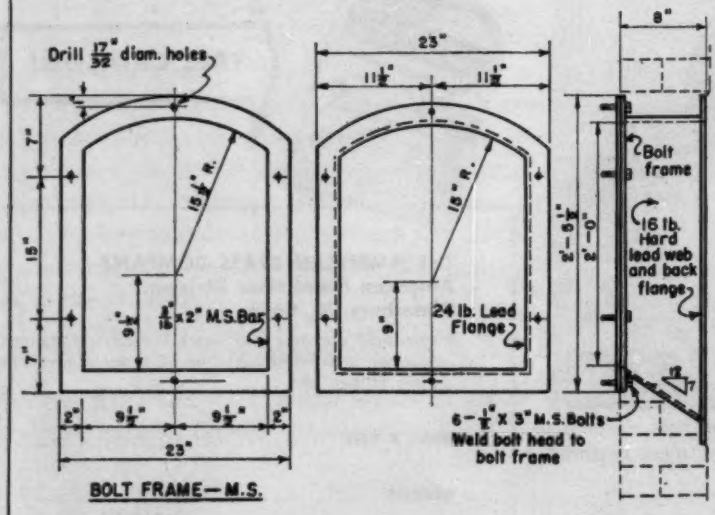
High Velocity Cooler Element


Lead "U" Bend
2" Cooling solution inlet grooved for Victaulic Coupling
3" Std. Pipe
125 lb. Std. Flange Gaskets
125 lb Std. dimensioned Hard lead chill cast flanges
Section showing extruded finned cooler pipe.

FABRICATION PROCEDURE:—

1. Make flanged steel pipe to required length.
2. Insert finned cooler pipe through mild steel pipe.
3. Place "full face" gaskets and lead flanges on each end of cooler element
4. Weld lead flanges to finned cooler pipe. and bolt securely.
5. Install in "Cooler" assembly.

Hard Lead Manhole Doorframe


Drill 17/32" diam. holes
23"
8"
Bolt frame
16 lb. Hard lead web and back flange
24 lb. Lead Flange
6 - 1/2" x 3" M.S. Bolts Weld bolt head to bolt frame
BOLT FRAME—M.S.

This month we present Part III of Best Designs for Lead Installations. The article contains information from a special company report "Application of Lead and Lead Alloys in the Chemical and Metallurgical Industries" just prepared by the Engineering Division of The Consolidated Mining and Smelting Co. of Canada, Ltd., Trail, B. C.—primarily for the edification of their maintenance personnel.

It is of particular interest to design, maintenance, and operating engineers in the chemical industry. Cominco's extensive experience as a user of lead in corrosive environments is embodied in the present series of articles.

High Velocity Coolers

When the solution to be cooled is of a corrosive nature, high velocity coolers (*see cut*) are used.

The wrought steel pipe is made up with the required flange face-to-face dimension, and the lead finned tube is inserted through the wrought steel pipe. Gaskets and hard lead flanges are slipped over the ends of the finned tube, and bolted securely to the wrought steel pipe flanges. The lead flanges are then welded to the finned tube. Assembly of the element in the cooler is self-explanatory.

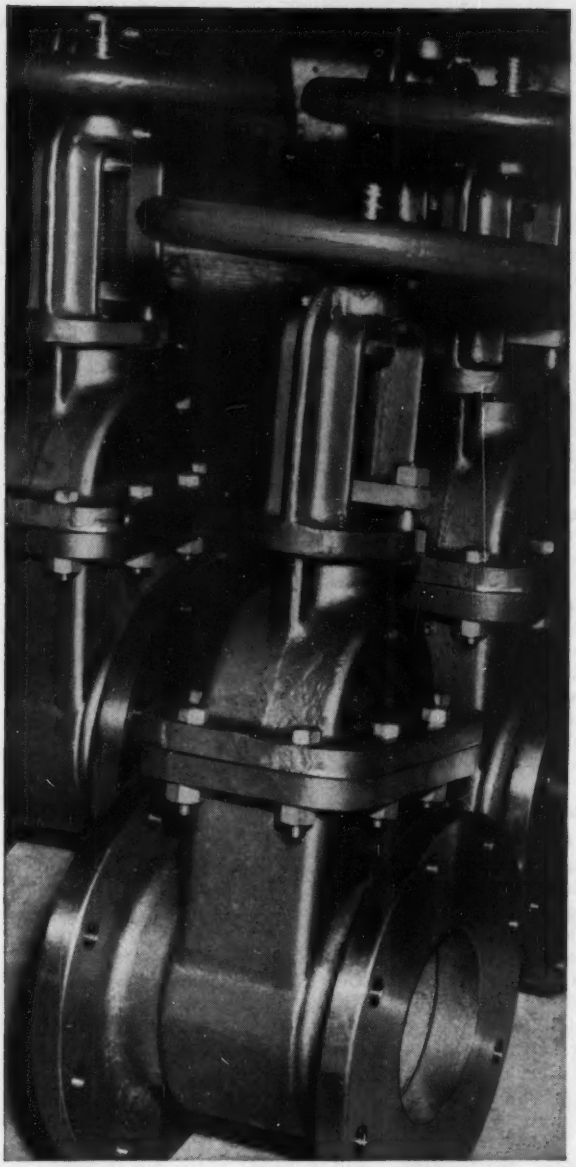
Lead Manhole Frames

Brick flues carrying corrosive gas are often equipped with man access openings.

Where lead is a suitable material to resist corrosion and the operating temperature is moderate, it has been customary to use a steel frame completely covered with lead. This has proven fairly reliable but comparatively

VALVES OF HASTELLOY Alloy D

Trade-Mark



INCREASE YIELD OF ALCOHOL PLANT

PROBLEM:

To control the flow of corrosive sulphuric acid in an alcohol-acid plant and to stop unscheduled shutdowns to repair corroded valves. The acid is in concentrations of 50 to 60 per cent and at temperatures up to 250 deg. F.

REMEDY:

Valves of HASTELLOY alloy D installed.

RESULT:

The entire unit now operates on a four-month inspection and repair schedule. There are no unscheduled down periods with accompanying loss in production.

HASTELLOY alloy D is resistant to all concentrations of sulphuric acid at temperatures up to and including the boiling points. In many instances, use of alloy D has increased yields in chemical processes by permitting higher acid concentrations and temperatures.

For a copy of a booklet describing HASTELLOY alloy D get in touch with the nearest Haynes Stellite Company Office.

HAYNES TRADE-MARK ALLOYS

HAYNES STELLITE COMPANY

A Division of Union Carbide and Carbon Corporation

UCC

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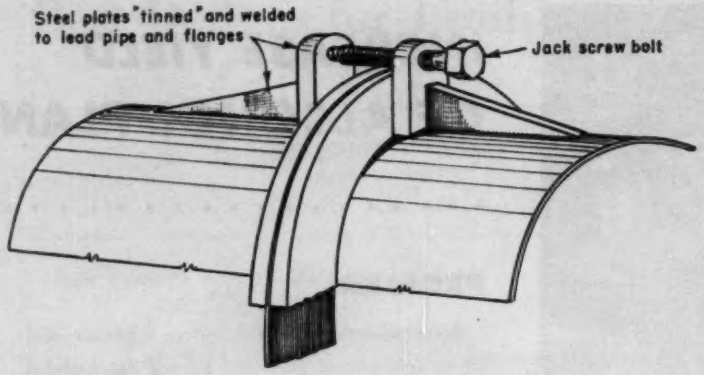
Separating Flue Flanges for Insertion of Blind Flange



expensive, and doubt always exists with respect to the state of the steel frame.

Recently, frames have been made completely of lead. The cost is generally reduced, mainly from the fabricating labor standpoint, and the performance in operation has been good (*see cut*).

Insertion of Blind Flanges

In acid plant flues carrying sulfur dioxide gas of high concentration, it is sometimes necessary to insert thin blind flanges between a set of flue flanges to sectionalize the system for maintenance.

Spreading of the flue flanges is sometimes a major undertaking, and the lead flanges may be warped by injudicious prying. To facilitate the insertion or removal of a blind flange, a jack screw arrangement has been devised for installation at points where this operation may be of common occurrence.

This is shown in the drawing. Number of these required at a given set of flanges will depend largely on the diameter of the flue.

Homogeneous Lead Lining

Often it is desirable to bond lead to steel, as in lead-lined steel vessels which are to operate under varying degrees of vacuum—or on rotating parts such as fan runners.

The effect on a loose lining or covering under these conditions is apparent without further explanation.

Various methods of bonding lead to steel have been devised. The most common method includes a step by which the steel is "tinned." From the standpoint of corrosion resistance, tin should not be used for the highest quality work. Another process has been developed where the use of tin has been eliminated. General descriptions of the two procedures follow.

Method Using Tin

The steel is cleaned by sand or grit blasting, or grinding. Care must be taken to be sure that no oil or grease comes in contact with the steel after it has been cleaned, and clean gloves should be used when handling the steel.

Chloride of zinc is applied to the cleaned surface. This is followed by an application of 50%-50% solder, either by torch or dipping in a molten bath of solder. Excess solder is wiped away while still in the molten state. When the solder has solidified but is still hot, the surface should be wiped with a cloth dipped in hot water to remove any remaining flux.

To apply hard or soft lead by means of a torch, the torch heat is applied to the tinned steel only long enough to melt the tin coating—after which the torch heat is directed to the lead being applied. Rigid adherence to this procedure will decrease the possibility of burning the tin away from the steel.

After the first pass of lead application, the surface should be examined for pinhole faults. This should be done very thoroughly, as it is one of the hazards of applying lead to steel equipment.

Any faults should be repaired by scraping down to steel, tinning and re-filling with lead. The first coat may then be scraped if required, and the second coat of lead applied. The surface should be checked for pinhole faults after each pass. Usually, three passes will build the lead thickness up to about ¼ in. After checking and repairing of the last pass, the surface may be scraped or machined to a smooth surface.

Method Without Using Tin

This method is precisely the same as above except that 6% antimonial lead is used instead of the 50%-50% solder, so that tin is eliminated from the process. No flux is used.

With rotating parts, it is very important that the lead-covered part be designed to withstand the stress set up by the centrifugal action. Properly designed, this application may be used on large parts. For example, excellent service has been given by a lead-lined fan impeller 8 ft. in diameter, operating at 560 rpm.

Fabricated Specialties

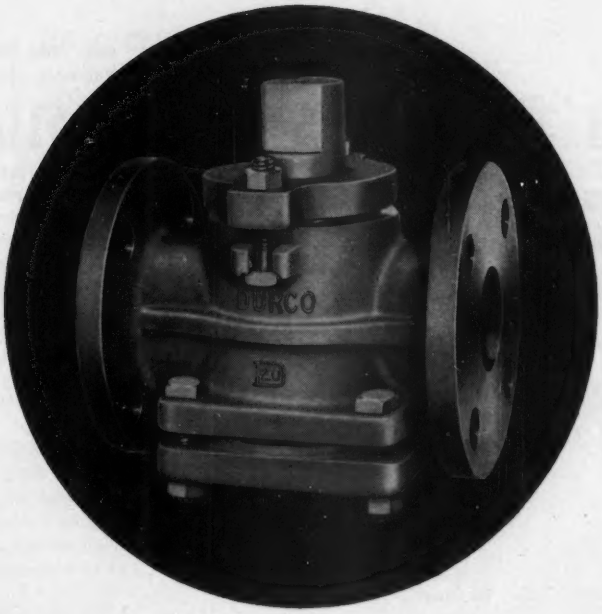
In the metallurgical and chemical industries, it is often expeditious to fabricate parts, not readily available, which will stand up to corrosive operating conditions.

The workability of lead lends itself to the easy fabrication of some of these parts. A foot-valve and a check valve which have proven themselves invaluable are shown. Air lifts have also been custom-built for the service required.

Lead Castings with Inserts

In the electrolytic refining of zinc, lead anodes are almost universally used.

The spanning lead bar top, to which the lead anode is welded, is often reinforced with ½ in. diameter imbedded steel bar to



Positions wanted, corrosive

The tougher the better!

The DURCO TYPE F VALVE with Teflon sleeve offers an unusually wide range of "experience" in chemical service—from fuming nitric acid and all concentrations of sulfuric acid to the mild salts and alkalies. Service conditions range from elevated temperatures in steam traced lines to below freezing applications. Service record: excellent!

How about these qualifications for your application? (1) Non-sticking; (2) No metal-to-metal contact; (3) Needs no lubrication; (4) Requires no packing; (5) Renewable sleeve and plug.

Full technical data quickly available through your DURCO representative, or write for Bulletin V/4a

DURCO TYPE F VALVE

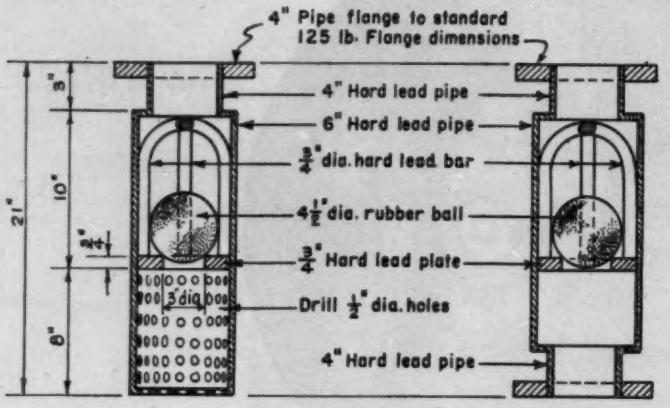
DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

Sizes ¼" through 2", in Durimet 20, Chlorimet 2, Chlorimet 3, Monel, Nickel, and other alloys.

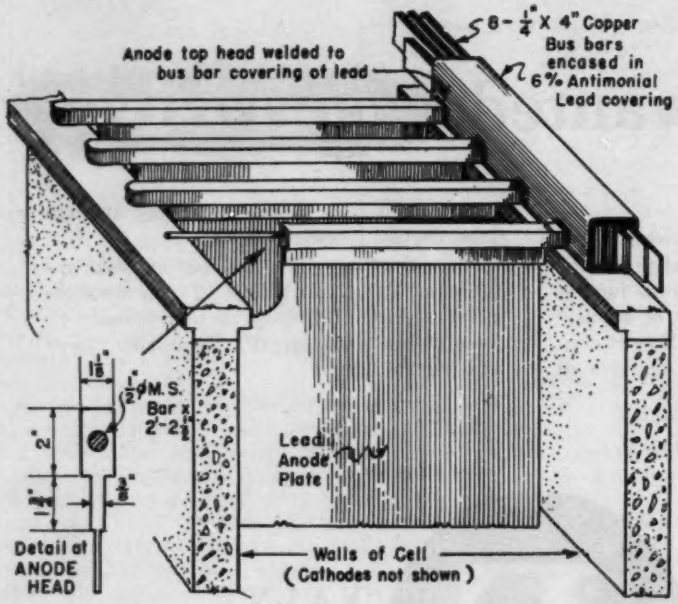
THE DURIRON COMPANY, INC., DAYTON, OHIO

Branch offices: Atlanta, Boston, Buffalo, Chicago, Cleveland, Detroit, Houston, Knoxville, Los Angeles, New York, Philadelphia, Pittsburgh

Lead Foot Valve **Lead Check Valve**



Construction at Anodes—Zinc Refining Cells



strengthen the support and conserve space.

Again in this same industry, the copper bus bars are cast in a 6% antimonial lead block, to which the ends of the lead anode bar tops are welded. The copper serves to carry the high-density current, and the lead facilitates welding of the anode bar tops to the lead-covered bus bar (*see cut*).

Lead Sand Castings

The list of products which may be cast in sand is innumerable. Anything that is useful in lead or lead alloy, from the simplest article to intricate centrifugal pump impellers, can be sand cast.

Some very common lead sand castings are flanged pipe fittings commonly-patterned according to the 125-lb. standard cast iron fittings. These are invaluable in the chemical industry.

Chilled Mold Castings

When large numbers of castings are required, it is economical to provide steel molds for repetitive casting. In this category are lead anode bar tops and lead flanges for lead pipe.

Since the mold can be made with a relatively smooth surface, machining of the parts is unnecessary unless a particularly smooth surface is required.

Summary

The field of useful application of lead and lead alloys is extremely broad, and it would be practically impossible to list all the successful applications in industry. Admittedly, the temperature-strength and thermal expansion relationships have to some extent limited this field.

Temperature-strength relationships of lead and lead alloys limit their use to operating temperatures below 400 F., and good practical design is necessary to use lead at the higher temperatures especially.

Thermal expansion of lead has limited its application in the past, but this limitation is being overcome as proper detail design and experience are used.

There is no finer testimonial to the metal lead than the fact that, despite all the metals and alloys that have been discovered and developed down through the years, lead has more than held its own against their combined competition.

New Lining Material

A new lining material can be applied to inexpensive containers, tanks, pipes, etc.—making them lighter and less expensive than alloy metals. It is made by the Garlock Packing Co., Palmyra, N. Y.

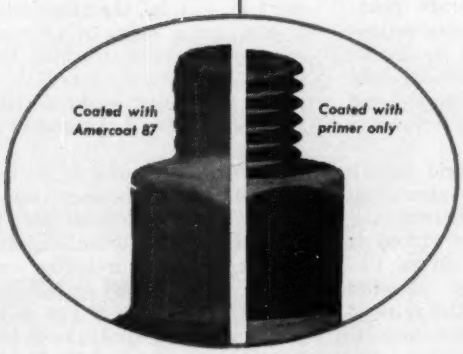
The lining material is a laminate of Kel-F plastic, fused and flowed into a glass fiber cloth backing. Conventional adhesives can be used to apply the laminate to practically any contoured surface. It can be applied to large

you can

CUT YOUR MAINTENANCE PAINTING COSTS UP TO 50% *with* AMERCOAT 87 VINYL MASTIC

HERE IS HOW THIS REMARKABLE PROTECTIVE COATING CAN SAVE YOU MONEY:

1. Only one cross spray coat over a primed surface is required for complete protection—this means lower labor costs.
2. Fewer scaffolding and rigging shifts are required.
3. Less down time—dries to touch in minutes, eliminates the risk of contamination between coats.
4. Greater thickness means longer life—lower cost per square foot per year.



Amercoat 87's thixotropic characteristic helps provide extra thickness on sharp edges and irregular surfaces; it is non-porous and will not crack or check.

Amercoat 87 combines the time-tested chemical and weather resistance of vinyl coatings with the thickness of conventional mastics, yet is easily applied with standard industrial spray equipment.

We will be pleased to send you our technical bulletin describing this coating in detail.

Amercoat
CORPORATION

DEPT. AE, 4809 FIRESTONE BOULEVARD, SOUTH GATE, CALIFORNIA Evanston, Ill. • Kenilworth, N.J. • Jacksonville, Fla. • Houston, Tex.

tanks and vessels right on-the-job without moving them to an applicator's shop.

Characteristics of the laminate include extreme chemical resistance to acids, alkalis, oxidants, and solvents; non-toxic; high abrasion resistance, tensile strength, dielectric strength, and electrical resistivity; high and low-temperature resistance; non-sticking, non-wetting surface; and low-temperature flexibility.

Applications already known for the laminate include: linings for tanks, ducts, pipe, pails, drums, surfacing for laboratory counter tops, floors, conveyor belts, resin casting forms, foam rubber molds, rolls.

Chemical Industry Program

Control of corrosion in the chemical industry is the theme of the May 9-10 meeting of Northeast Region, National Association of Corrosion Engineers. The meeting will be held at University of Buffalo with arrangements by Niagara Frontier Section NACE and the university.

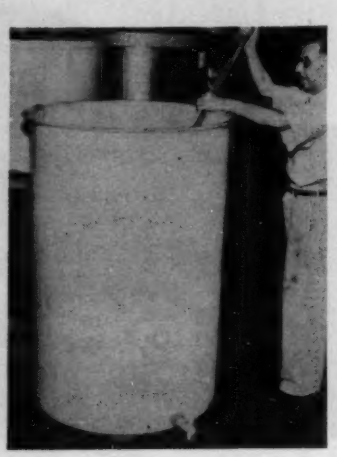
Emphasis will be on the proper use of metals and alloys to prevent corrosion. The tentative program for the technical portion of the meeting has been arranged as follows:

Wednesday, May 9—Morning: Fundamentals of Metallic Corrosion by Milton Stern, Metals Research Laboratory, Electro Metallurgical Co., Niagara Falls, N. Y.; Iron-Base Alloys by S. H. Kalin, Applied Research Laboratory, United States Steel Corp., Monroeville, Pa.

Afternoon: Stainless Steels by C. P. Dillon, Carbide and Carbon Chemicals Co., Union Carbide and Carbon Corp., Texas City, Tex.; Copper and Nickel-Base Alloys by H. O. Teeple, The International Nickel Co., New York.

Thursday, May 10—Morning: Aluminum and Magnesium Alloys by H. P. Godard, Aluminum Laboratories, Ltd., Kingston, Ont.; Metallic Coatings, by W. W. Bradley, Bell Telephone Laboratories; Lead by Kempton H. Roll, Lead Industries Association, New York.

Afternoon: Titanium, Zirconium and Tantalum by W. E. Lusby, E. I. du Pont de Nemours & Co., Inc.; High-Alloy Materials by E. D. Weisert, Haynes Stellite Co., Div. of Union Carbide and Carbon Corp., Kokomo, Ind.; Chemical Plant Problems by M. G. Fontana, Ohio State University, Columbus.



One-Piece Tanks

New low-cost chemical tanks with capacities of 5 to 160 gal. are molded of polyethylene in one continuous piece to prevent leaks and corrosion. The non-breakable walls of these new tanks are translucent enough to reveal the level of liquids inside.

These tanks have wide use for mixing, storage, compounding and processing of foods, pharmaceuticals, salts, water softeners, and cleaning or plating of metal. They may be used to hold strong caustics, water, and strong or weak acids—even hydrofluoric acid.

A 160-gal. tank, rigid enough to be completely self-supporting, is used to mix fine pharmaceuticals (*see cut*). It is produced by Delaware Barrel & Drum Co., Wilmington, Del. of Bakelite polyethylene. The outlet valve at the base of this large tank is also made of polyethylene.

Molding these tanks in one piece eliminates the possibility of weak joints, welds or seams—and reduces the danger of leakage. Shapes available: cylindrical, cubical or rectangular—together with covers.

Bibliographic Survey of Corrosion is Published

More than 4,400 abstracts and 4,000 authors are classified and indexed in the 1950-51 Bibliographic Survey of Corrosion, now available from the publishers (National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2, Tex.). The book sells to members of the National Association of Corrosion Engineers for $10, and to non-members for $12.50. It contains 430 pages and a seven-page preface.

This is the fourth of the series of bibliographies published by NACE. The others are 1948-49, 1946-47 and 1945. Each volume includes abstracts of corrosion literature published in the indicated years, classified according to the NACE's Abstract Filing System—including both alphabetical subject and author indices. The four volumes contain 12,414 abstracts and were made available to the association by more than 30 abstracting agencies.

Corrosion Test Kit

A convenient kit for testing tantalum either in the laboratory or in process equipment is available from Fansteel Metallurgical Corp., North Chicago, Ill. The kit consists of two pieces of 0.020 in. thick tantalum sheet, one 1 in. × 1 in., the other ½ in. × 4 in., and a length of 0.030 in. tantalum wire for attaching the specimens.

The sheets are stamped with a serial number for convenient identification.

Tantalum is known to be immune to attack by most acids, even at boiling temperatures. It is inert to wet chlorine, chlorine dioxide, bromine or iodine and almost all halogen compounds except fluorides. It is also inert to organic and food chemicals. Tantalum is attacked by hydrofluoric acid, oleum and other substances containing free SO_3, and by strong alkalis.

The corrosion test kit is available to production, pilot plant or research technicians without charge.

NEW TYPE ELECTRO-PERMANENT MAGNETIC HI-VI VIBRATORY EQUIPMENT INTRODUCED BY ERIEZ

No Rectifier Needed!
Exclusive "Double Action" Drive
Gives Superior Performance
at Lower Operating Costs!

Eriez, famous for permanent-powered magnetic equipment for industry, introduces a revolutionary line of Electro-PERMANENT Magnetic Unit (Bin) Vibrators and Feeders. Operating at 3600 CPM directly off an AC line, all you do to these powerful, compact units is plug them in . . . and they go to work! THERE'S NO RECTIFIER NEEDED!

Look at HI-VI's Many Operating Advantages

LOWER MAINTENANCE and OPERATING COSTS . . . LONGER, TROUBLE-FREE SERVICE . . . VERSATILE UNITS PROVIDE BROADER OPERATING RANGES WITH LESS POWER CONSUMPTION . . . HI-VI UNITS ARE COMPACT, LIGHTWEIGHT, EASILY INSTALLED, NEED NO REALIGNING . . . NO SLIDING OR ROTATING PARTS TO WEAR . . . No lubricants needed . . . Noise factor is reduced, working conditions improved . . . New type "double action" drive provides higher operating efficiency with low operating cost . . . Many HI-VI models are totally enclosed, weather-and dust-resistant.

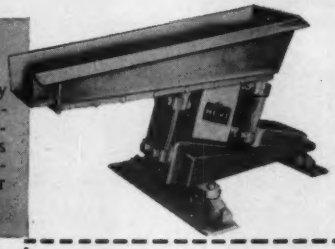
HI-VI's operating principle

The heart of the HI-VI units is a permanently powered Alnico V magnetic element. This replaces, in effect, rectifiers by providing an inherent magnetic rectification system which provides more operating forces, no lost efficiency. All energy (two-way push-pull vibrating action) goes for productive performance.

HI-VI Unit (bin) Vibrators . . . keep materials flowing freely

(Pat. Pending)

Units AUTOMATICALLY SELF-ADJUST to meet any load requirements. They eliminate pile-ups, sticking, bridging and arching of bulk materials flowing out of or through containers. Materials are kept flowing in a smooth, steady stream through hoppers, bins, chutes, etc., by the exclusive double diaphragming (kneading) action of the HI-VI unit.



HI-VI Vibratory Feeders . . . for accurate, controlled feed

Bulk materials are conveyed, spread, agitated, separated, blended, dried and mixed —automatically—by the vibratory action of the HI-VI Feeder. Unit requires little space, and operates at any desired speed, variable from ounces to tons per hour. For all types of materials: hot, dry, damp, dusty, lumpy, abrasive, etc.

ERIEZ HI-POWR MAGNETIC SEPARATORS

ERIEZ HI-VI VIBRATORY EQUIPMENT

HI-VI is the newest product of the Eriez Manufacturing Company, pioneer producer of permanent-powered magnetic Separators for industry. Eriez HI-POWR Magnets are used to purify, retrieve and separate in processing lines of all types, and are available in a wide range of styles and sizes.

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74EV MAGNET DR., ERIE, PA.

Please send information on the new HI-VI vibratory equipment to:

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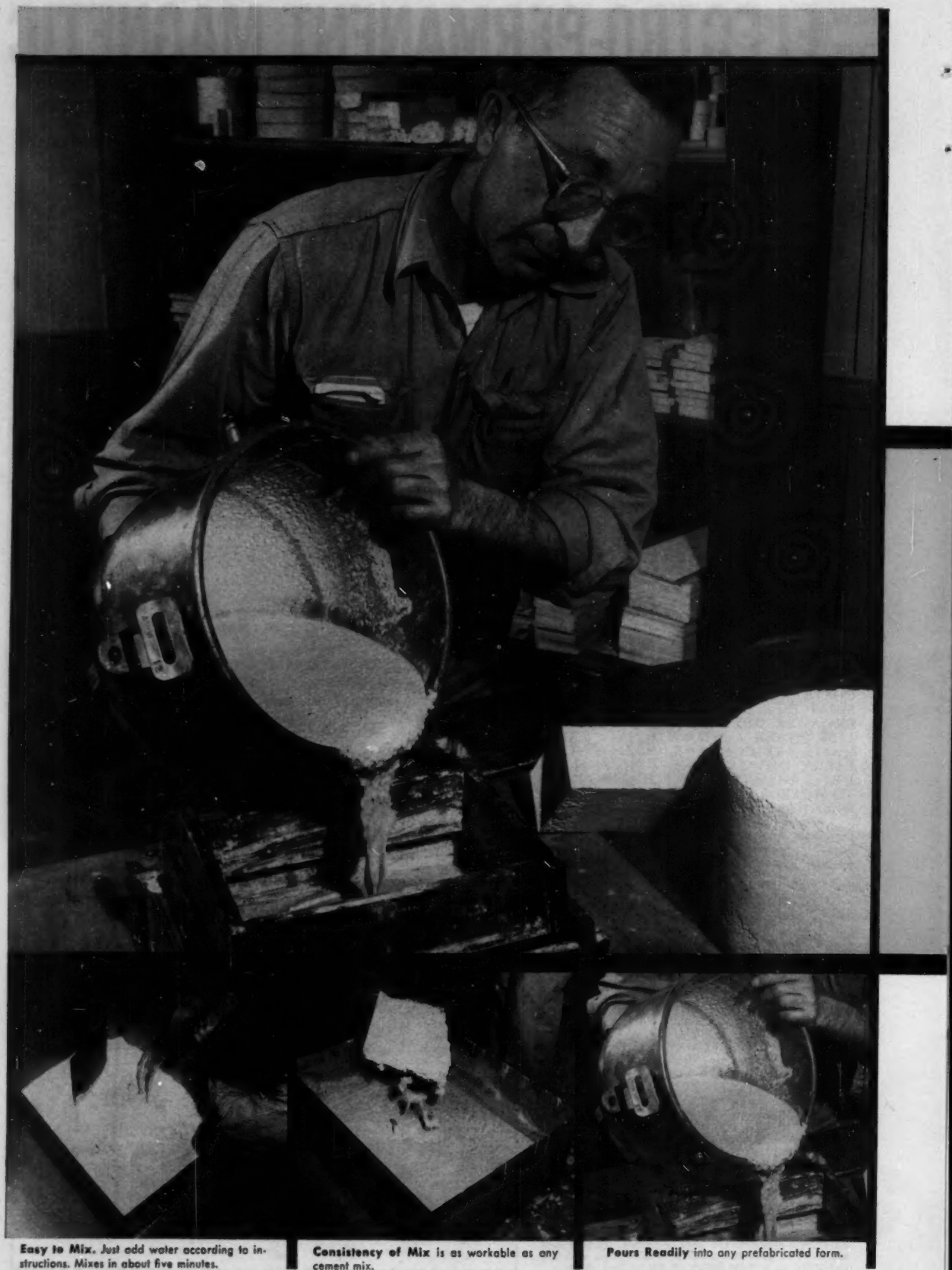

Easy to Mix. Just add water according to instructions. Mixes in about five minutes.

Consistency of Mix is as workable as any cement mix.

Pours Readily into any prefabricated form.

New ALUNDUM* 33-I insulating castable...mixes and pours like concrete...protects to 3300°F.

A New Norton Refractory Rx

Now you can protect critical areas in your furnaces and other high temperature equipment to 3300°F with ALUNDUM 33-I insulating castable — a new, easy-to-install NORTON Refractory Product.

- 33-I comes in dry form in moisture-protective bags.
- 33-I — You just add water according to instructions. Mixes readily.
- 33-I pours into any prefabricated form like a concrete mix.

And . . .

- 33-I insulates up to 3300°F.
- 33-I is light in weight and monolithic in structure.
- 33-I saves down time for repairs.

Characteristics of ALUNDUM 33-I

Density	100 lbs. per cu. ft.
Setting up time	
Stiffens	1 hr.
Initial set	4 hrs.
Final set	18-24 hrs.
Chemical Analysis — Al_2O_3	Primarily
SiO_2	< 0.1%
Fe_2O_3	< 0.1%
Maximum hot face temperature	3300°F
Water added per 100 lbs.	Approx. 4¼ gals.
Grain Size	6F

This newest Norton refractory Rx is *engineered and prescribed* for maximum protection and quick, easy installation in a wide range of uses. For further facts on ALUNDUM 33-I insulating castable, write to NORTON COMPANY, Refractories Division, 504 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

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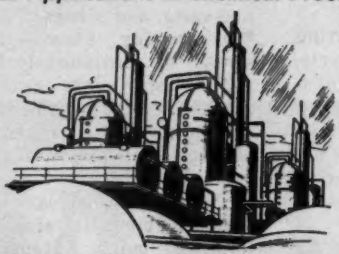
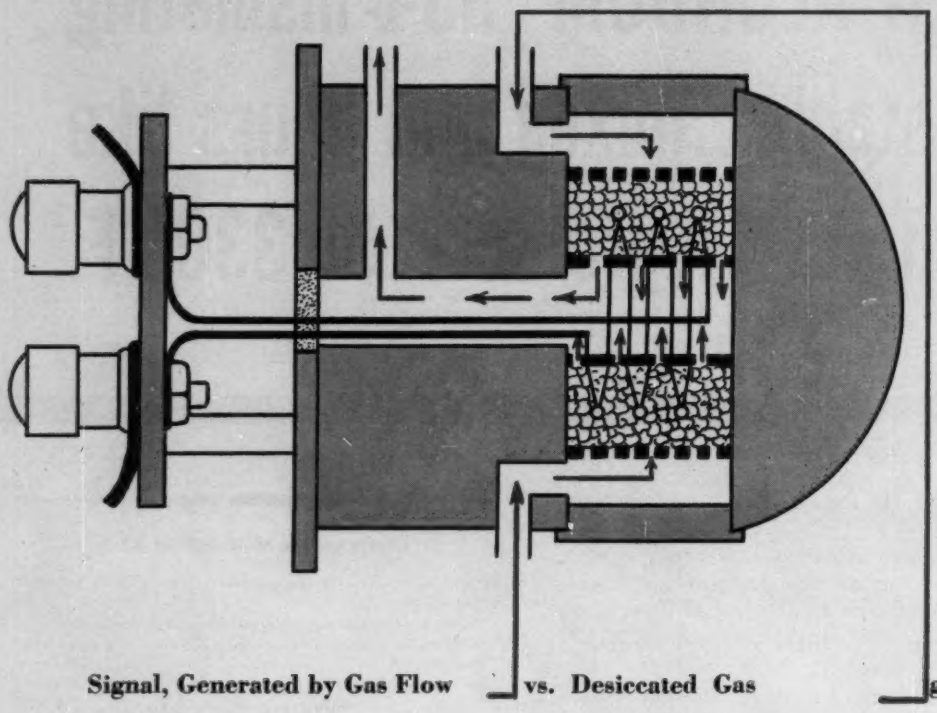
Typical Applications in Chemical Processing



Insulation for high temperature reactors and furnaces.

NORTON
REFRACTORIES
Engineered... Rx ...Prescribed
Making better products... to make your products better



Signal, Generated by Gas Flow vs. Desiccated Gas gives . . .

Closer Check on Gas Dryness

New method records low concentrations of water vapor in air or gas streams. Instrument provides data for tolerance limits.

Moisture problems in air or gas pipelines are solved by a new continuous, automatic method with an instrument that records low concentrations of water vapor. Continuous monitoring by the instrument keeps gas below the critical moisture concentration where hydrates form.

Drying towers can be operated more efficiently because the monitor assures that towers will regenerate just prior to or at the time of the first breakthrough. Instrument prevents moisture damage to process catalysts by monitoring the feed streams.

Method offers a new means of gathering data for establishing water tolerance limits. Such work has been hampered in the past by lack of sensitive and reliable automatic instrumentation.

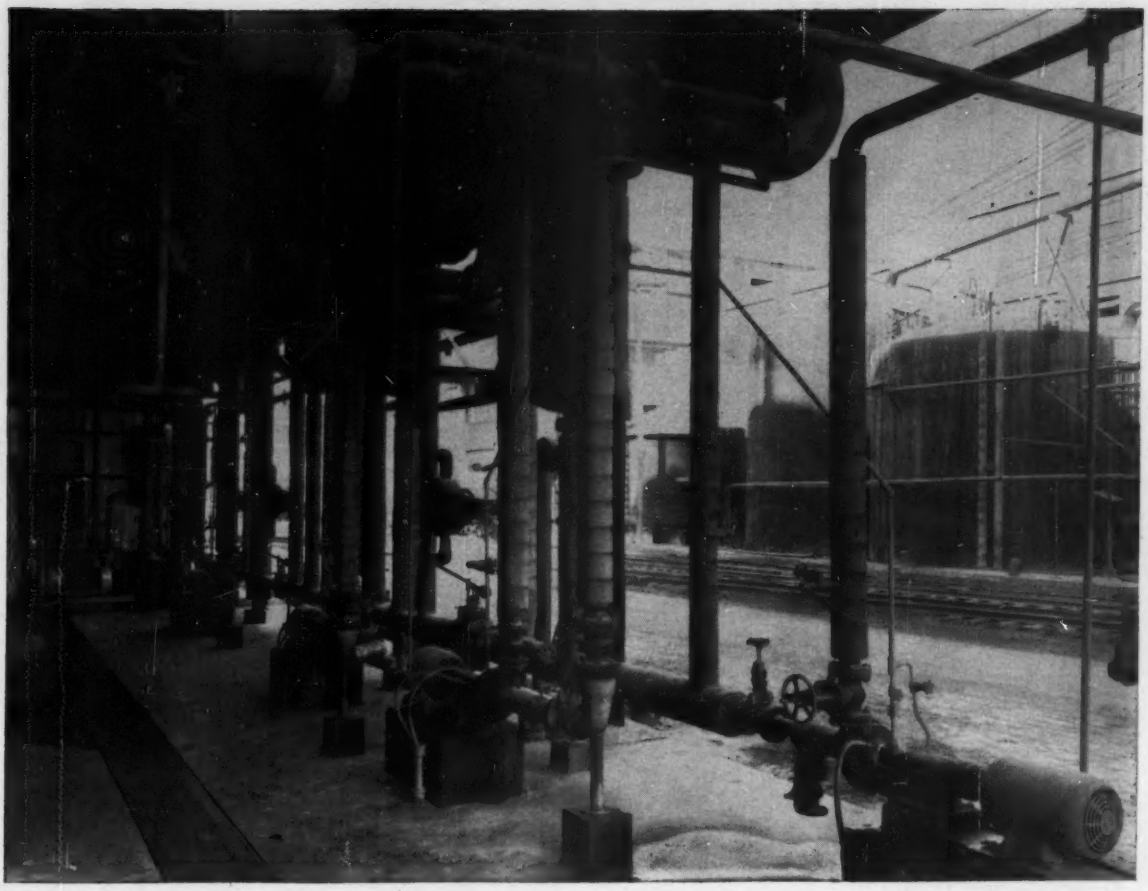
▶**Operating Traits**—Operating on a 4-min. measuring cycle, method has been used in instruments with a full scale range of 100 ppm. water by volume. And even lower full scale ranges appear possible. Also, instruments can be made which will record higher ranges.

A sensitivity of 0.25 ppm. by volume has been attained. Accuracy is limited by noise level and calibration errors to 1 ppm.

▶**New Approach**—Principle of operation is new and based on the heat energy exchanged when a gas is adsorbed on or desorbed from the surface of a solid adsorbent. It is more adaptable to continuous measurement and recording than existing methods such as the hair hygrometer, wet and dry bulb thermometer, electrical conductivity of hygroscopic liquids and salts, and others.

▶**Alternating Flow** — Sample stream of continuously flowing gas is split into two equal streams. One stream is dried completely by a regenerative adsorption column; the other remains as is.

Then, the two streams are fed through opposite sides of a detector cell. Automatically-timed-and-operated three-way valves switch flows during the 4-min. cycle to expose desiccant



They Handle the Tough Ones!

LaBour Pumps have been handling tough chemical jobs dependably for more than 30 years.

For example, the black liquor evaporating process of a large Southern paper mill, shown above, has LaBour pumps handling its particularly tough job. The designing engineers knew they could count on LaBour pumps to give them continuous daily service without breakdown, without stoppage.

It is not uncommon to find a LaBour pump that has been performing thousands of hours without interruption. This enviable record, that LaBour has established, is not an accident. Each LaBour pump must pass an actual performance test before it can leave the factory. This rigid inspection and testing enables LaBour pumps to enjoy an unusually high rating in plants handling chemicals.

If you have a tough job to handle, get the pump that handles it best . . . LaBour. It's the pump the experts specify.

LABOUR

THE LABOUR COMPANY, INC. • ELKHART, INDIANA, U.S.A.

Newsworthy Equipment This Month

Equipment Cost Indexes, p. 240

New Instruments & Controls
- Gas Moisture Recorder 236A
- Surface Thermometer 240A
- Pressure Gage 240B
- Probe Assemblies 240C
- Heat Flow Monitor 240D
- Dust Recorder 240E
- Gage Saver 240F
- Thermocouple 240G

New Fluids Handling Equipment
- Pump Laboratory 242A
- Timer Valve 244A
- Centrifugal Fan 244B
- Alloy Pumps 244C
- Midget Pump 244D
- Visible-Wedge Valve 244E

New Heating & Cooling Equipment
- Vapor Condenser 246A
- Heat Exchangers 246B
- Oven Burner 246C
- Cooling Tower 246D
- Hot Oil Heater 246E

New Maintenance Tools & Supplies
- Fire Monitor 248A
- Radiography Unit 248B
- Absorbent Spreader 248C
- Tube Expander Drive 248D
- Cleaning Tool 248E

New Packaging & Handling Equipment
- Drum Truck 250A
- Weighing System 250B
- Belt Conveyors 250C
- Drum Lift 250D
- Elevator-Conveyor 250E

New Electrical & Mechanical Equipment
- Flexible Coupling 252A
- Compressor Engine 252B
- Wiring Conduit 252C
- Gear Drive 252D
- Motor Control 252E
- Emergency Light 252F

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in each side of the cell alternately to each stream for two minutes.

Both adsorption and desorption proceed simultaneously. During each half cycle the temperature differential in the cell rises rapidly, passes through a maximum and then diminishes slowly.

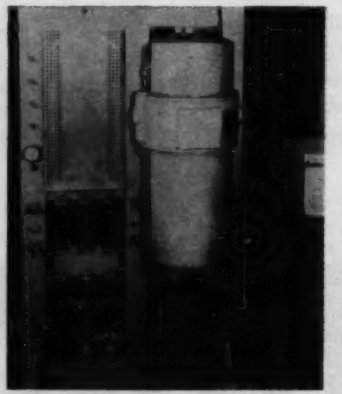
When the maximum is passed, flow switches and the moisture and temperature equilibration process repeats. In the second half cycle, the desiccant and stream which lost heat in the previous half cycle gain heat; the reverse takes place in the other side of the cell.

A number of thermocouples in the two desiccant beds are connected in a circuit to develop an electrical potential. Resulting emf. is proportional to the algebraic sum of the gain of heat on one side of the cell and the loss of heat on the other side.

When flow switches, the emf. generated is equal, but of opposite polarity to that of the previous half cycle.

▶ **Recording** — Relatively high signals are obtained for low water vapor concentrations by using many couples in series in the differential thermopile. The swinging signal can be rectified by either of two methods, each incorporating a specially designed peak-to-peak voltmeter. Special voltmeter is needed because signal from the cell oscillates only one-quarter cycle per min.

Both methods produce a chart record showing deflections in one direction only from zero. Thus, signal can be used to operate control equipment.



COMPLETE instrument includes regenerative dryer, recorder and timer.

▶ **New Applications** — Applicability of the instrument is determined preferably by test. However, response to be expected from known concentrations of water in a given gas can be estimated from the formula $E = k(CL/c_p)ne$ where E is peak-to-peak emf., volts; k is cell constant; C is concentration of water vapor, grams; L is the latent heat of vaporization of water, calories per gram; n is the number of pairs of couples; e is emf. per couple pair per deg. C., volts; c_p is the specific heat of the gas mixture at constant pressure, calories per gram per deg. C.

The cell constant, k, can be determined experimentally with known concentrations of water vapor in air. For other gas mixtures, it is necessary to know whether any of the gases are adsorbed on the desiccant and which is most strongly adsorbed. Cell output then can be estimated by using the difference between the latent heat of this component and the latent heat of water.

Differential heat of adsorption, if it is known for the gases and desiccant used, will give closer estimates of the response

How electronics makes P-K exchangers better than ever

This man is expanding tube ends into the tube sheet—the "inner face" of a shell and tube heat exchanger that holds each tube in place. By doing it electronically, with the equipment you see here, the circumference of each tube is joined to the face of the exchanger with exactly the same pressure.

This minimizes the possibility of leaks developing—even when a mile of tubing and hundreds of tube ends are involved, as they are in many of P-K's special exchangers.

But fabricating procedures like these are only part of the story. Every P-K unit is "computed" for its thermal rating and design.

This automatic check of a unit's thermal rating is not only a safeguard, but can often save you money. And it allows P-K to give a full and complete guarantee that each unit will perform at its rated heating or cooling capacity.

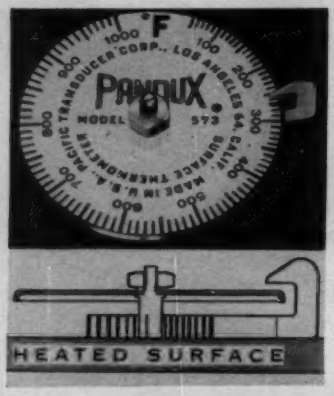
An increasing number of processors, engineers, and contractors have come to rely on P-K's painstaking fabrication and testing procedures —and their check, and double-check, of a unit's thermal rating. We would be pleased to design and build exchangers for you.

The Patterson-Kelley Co., Inc.,
150 Lackawanna St., East Stroudsburg, Penna.
Offices in principal cities.

PATTERSON KELLEY

Heat Exchangers • Converters • Storage Water Heaters • Condensers • Storage Chillers • Oil Heaters • and all types of heat transfer equipment

to be expected. In most cases, the differential heat of adsorption may be as much as two times greater than the latent heat. Sensitivity estimated by the formula will be slightly conservative.—**Mine Safety Appliances Co., Braddock, Thomas & Meade St., Pittsburgh 8, Pa.** 236A



Surface Thermometer

Has range from 50 to 1,000 F.

The Spot Check surface thermometer made entirely of stainless steel is easy to read, compact and fast. It will measure ambient temperatures, as well.

Instrument is merely laid on the surface to be checked. Within 60 seconds it will reach a constant, exact reading.

Thermometer comes accurately calibrated within ±2%. If necessary, it can be reset by the user at any time.—**Pacific Transducer Corp., 11836 West Pico Blvd., Los Angeles 64, Calif.** 240A

Pressure Gage

Operates at high temperature.

A pressure gage that is not sensitive to temperature has been developed for use under prolonged exposure to high temperature and radiation.

Instrument consists of a bellows, a differential transformer and a meter to indicate variations in the transformer output. Core of the differential transformer is linked directly to the bellows.

Any change in pressure on the bellows moves the transformer core. This, in turn, induces a variation in the output of the transformer.

Gage may be installed on any pipe or vessel for use with high temperature liquids or gases. The pressure-sensing bellows may be manufactured from a wide choice of materials.—**Callery Chemical Co., Callery, Pa.** 240B

Probe Assemblies

For control of liquid level.

A complete line of probe assemblies has been introduced for controlling liquid level in the processing industries.

Each assembly is ruggedly constructed. For example, the MEK-3048A double-electrode probe incorporates special electrodes made with alumina insulation. Conducting portions of the electrode are stainless steel. Electrodes are mounted in a special weather-resistant enclosure that can be supplied in choice of bronze, cast iron, or stainless steel.

Assemblies can be furnished to fit 1½ or 2½ in. ferrules.—**Machinery Electrification, Inc., Northboro, Mass.** 240C

Heat Flow Monitor

Gives direct reading of heat flow.

First of several control instruments to incorporate a new heat-flow disk is the HFG-2 Heat Flow Monitor. This compact, portable unit reads directly in Btu. heat flow through any surface in contact with the disk. It can be used to check scores of problems ranging from the efficiency of structural, pipe or window insulation to exploring the heat loss of refrigerated or heated areas.

Measurements can be made in ranges of 0-30, 0-60, 0-300 and 0-600 Btu./sq. ft./hr. Precision of readings is 1% and meter accuracy is 0.3%. Contact surface should not be higher than 160 F.—**National Instrument Laboratories, Inc., 6108 Rhode Island Ave., Riverdale, Md.** 240D

Dust Recorder

Rapidly indicates minute amounts of dust.

A highly sensitive dust-recording instrument has been developed to give an accurate measure of dust conditions within seconds. It also provides a continuous record of dust levels.

Recorder sucks air through a narrow tube and blows it at supersonic speed against a thin, plastic sheet. Density of the dust deposit is measured photoelectrically and recorded. Microscope on recorder permits making a visual check of the nature of the dust.—**Eastman Kodak Co., 343 State St., Rochester 4, N. Y.** 240E

Gage saver for hydraulic, fuel or pneumatic system is designed for maximum pressure of 10,000 psi, can be furnished as standard unit for 50 to 5,000 psi.—**Fisher Controls Co., 1222 Seventh St., Santa Monica, Calif.** 240F

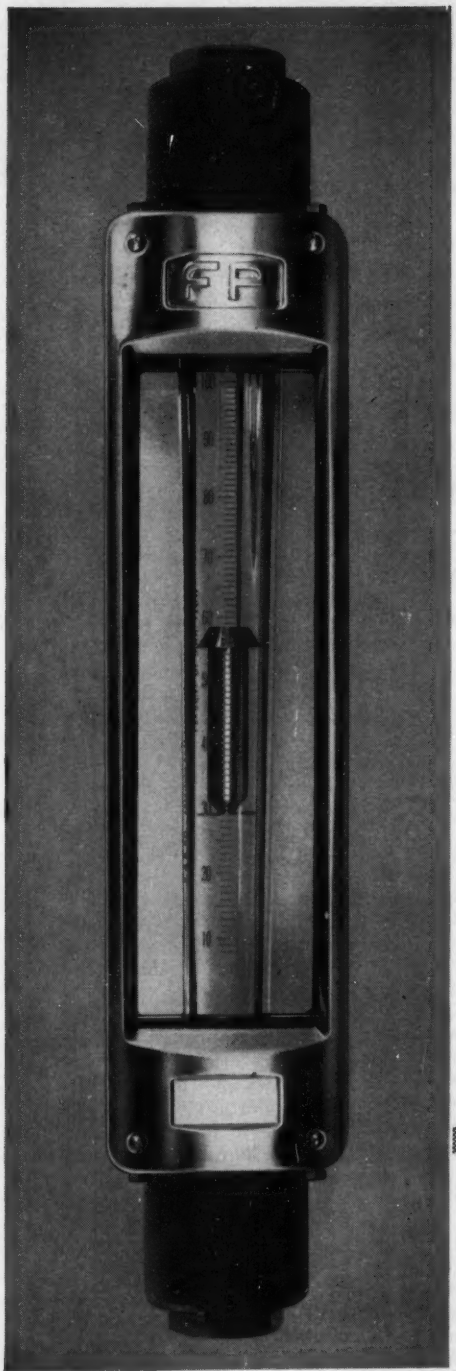
Thermocouple for high temperature, high pressure service consists of silica-free ceramic tube which houses platinum purge tube and platinum-platinum rhodium couple.—**Trinity Equipment Corp., Roselle Park, N. J.** 240G

Equipment Cost Indexes

Industry	Sept. 1955	Dec. 1955
Avg. of all	191.0	196.9
Process Industries		
Cement mfg.	182.8	188.8
Chemical	191.8	198.1
Clay products	177.6	183.4
Glass mfg.	181.2	187.1
Paint mfg.	184.6	190.6
Paper mfg.	184.9	190.9
Petroleum ind.	188.3	194.5
Rubber ind.	190.8	197.0
Process ind. avg.	188.9	194.6
Related Industries		
Elec. power equip.	193.6	199.9
Mining, milling	193.0	199.3
Refrigerating	211.8	219.0
Steam power	180.7	186.6

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See *Chem. Eng.*, Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1956, pp, 194-5 for annual averages since 1913.

BEFORE YOU VOTE



check this candidate for accurate flow measurement

Standardizing on one line of flowmeters has many benefits. But before you vote for a specific line of meters check *all* the advantages of F&P 1700 Series Flowrator meters. More and more companies are voting F&P meters their standard. Here are a few reasons why:

- ☒ **The Rugged Enclosure** of the 1700 Series flowmeter provides wide-angle 130° visibility, increased strength, attractive appearance and freedom from tube stress.
- ☒ **One Basic Design** permits three types of enclosures, 360° "rotability" of connections, interchangeability of parts and packing, and ease of maintenance.
- ☒ **The Built-in Mounting** feature requires no additional accessories for front or rear panel mounting.
- ☒ **Maximum Corrosion Resistance** is assured by a choice of more than 20 materials of construction and the all-stainless steel enclosure.
- ☒ **Readily Available** from warehouses in Hatboro, Houston, Los Angeles or Chicago.
- ☒ **The Dependable Performance** of F&P Flowrator meters has made them the accepted standard throughout industry for 19 years.

Compare, consider, try—and then pick your choice for standardization. We're sure you'll vote a straight F&P ticket.

FISCHER & PORTER CO.

156 County Line Road • Hatboro, Pa.

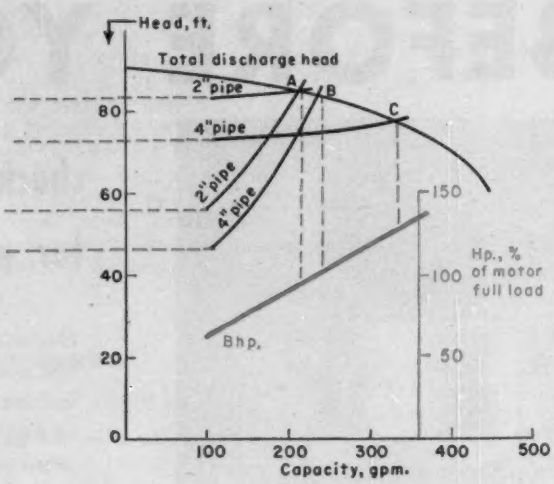
Write for Catalog 10-A-25 completely describing the 1700 Series Flowrator meters.

LA1079

Different traits . . .

Static head, non-Newtonian slurry

Static head, Newtonian slurry



Highlighted by test loop

Pump Lab Spots Potential Trouble

Slurry system pumping can booby trap the unwary. New slurry pumping lab probes slurry systems before pump is specified, guards user from grief.

When you pump slurries, anything can happen and frequently does. Especially if you assume that all slurries are alike and not too different from liquids in general.

To guard users from the grief associated with such a gross misconception, Morris Machine Works now operates a slurry test laboratory. Here, flow characteristics of a given slurry are checked out thoroughly in a system of test loops before pump and pipe sizes are recommended to do the job most efficiently.

▶ **Information Please**—Most, if not all slurries, exhibit non-Newtonian flow. In other words, a plot of shear stress vs. rate of shear is not a straight line starting from zero. Translated into pipeline flow this means that a plot of friction drop vs. velocity will be nonlinear.

The most reliable way to determine this plot is to check flow of the slurry through a pipeline system. Then by superimposing this plot on pump operating curves, operating limits can be set.

A second big factor in successful slurry pumping is critical flow velocity. Below this value for a given slurry, particles will settle in the line to cut off flow.

Once solids start settling in a slurry system operating with a centrifugal pump, they cut pipe cross section. This increases the system head.

In accordance with the head-capacity curve, capacity drops and rate of plugging increases until flow stops. It's a vicious circle and can only be avoided by establishing critical velocity and designing the system so that flow is always above this value.

▶ **Checking the Facts** — One morning recently we walked into the Morris laboratory just as test engineer Roy Roberts threw the switch on the pump drive motor for the slurry test loop. In between shouts from Roberts to his assistants as they tended valves, weigh tanks, instruments, etc., we pieced together what actually was happening.

A 71% slurry of cement was coursing through the 2-in. section of the loop. Speed of the type R 3-in. pump was changed stepwise to give a range of velocities up to 168 gpm.

At each velocity, pressure drop across an 18-ft. section of pipe was taken from a differential manometer. With the aid of a mirror, flow through a transparent section was checked for settling. Flow rate was obtained by diverting flow into a weigh tank for a timed interval.

Similar tests were run on flow characteristics through a 4-in. loop. Also, available is a 3-in. loop which was not used on this particular morning.

Return loop of system includes a length of glass pipe connected between flexible hoses. By rotating this section of pipe vertically through 180 deg., slurry can be viewed flowing downward, horizontally or upward. Particular attention centers here when handling large particles.

▶ **Correlation** — In conjunction with the flow tests, engineer Roberts and assistants determined solids concentration,

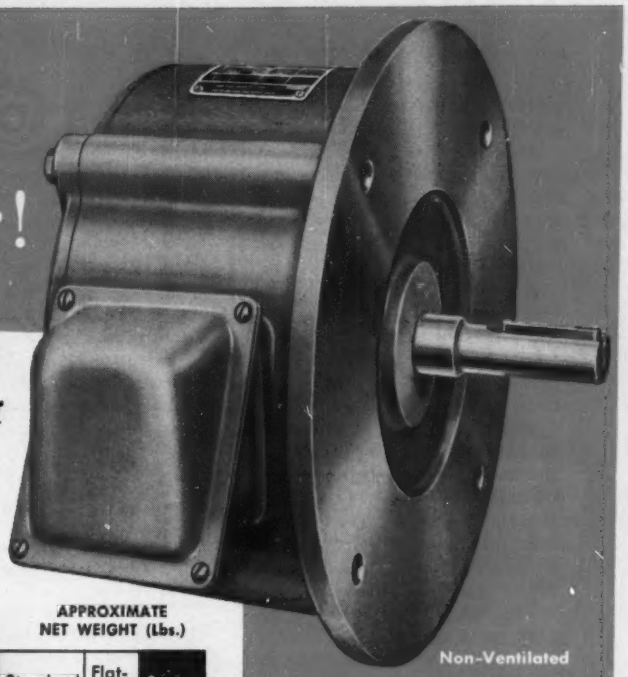
The Motor you asked for!

TAKES less space . . . because it's the new FLAT-Type Motor

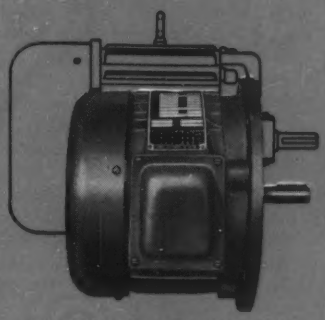
GIVES more service . . . because it's a DIEHL

FOR SIZE AND WEIGHT, COMPARE THE NEW FLAT-TYPE WITH STANDARD MOTORS

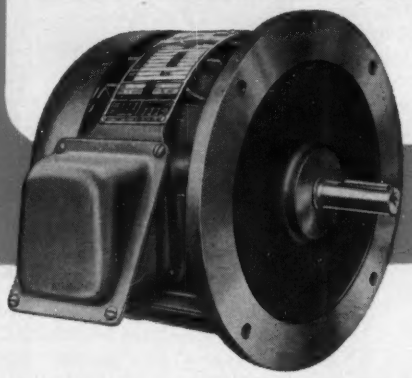
FRAME SIZE		OVERALL LENGTH (Inches)			APPROXIMATE NET WEIGHT (Lbs.)		
Standard	Flat-Type	Standard	Flat-Type	Saving	Standard	Flat-Type	Saving
DIF 182	DIF 180	14 1/16	10 3/4	3 5/16	82	59	23
DIF 213	DIF 220	17 3/16	11 5/16	5 7/8	128	83	45
DIF 284U	DIF 280	26	13 13/16	12 3/16	272	135	137



Non-Ventilated



New Flat-Type superimposed on standard motor



Fan Cooled

The unique and perfect answer in *integral motors*—designed especially for the machine tool and equipment industries. Packs full horsepower in less space . . . actually up to 48% shorter than standard motors without sacrifice in performance. Many pounds lighter, too, than conventional motors (over 50% in some cases), meaning vastly reduced over-hung weight. Standard radial construction, easy to disassemble and reassemble . . . no precision alignments or complicated air-gap adjustments to contend with. Totally-enclosed . . . no dirt, dust or moisture can get in. Available (non-ventilated) in ratings to 3 H.P., and (fan-cooled) in ratings to 20 H.P.

Perhaps the Diehl Flat-Type Motor is just what you need to solve your application problems. Give us the details and we'll be glad to submit recommendations. Ask for your copy of Bulletin CE-3461

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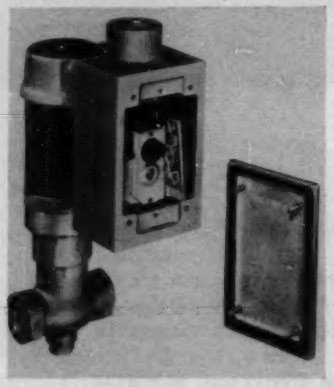
viscosity (Brookfield), specific gravity and screen analysis.

Attempts are made to correlate viscometer shear tests with the flow tests. Some correlations have been checked out by further laboratory and field tests.

A simpler indication of critical carrying velocity is being sought by attempts to correlate measured flow test values with free-fall velocity of a particular particle, as determined in a settling tube. So far, only general assumptions can be made, but the method looks promising.

▶ **Scale-Up** — Test work in the Morris laboratory has given the company a sounder basis for recommending operating systems. Calculations have been developed for scaling up reliably from test data to commercial size where it exceeds test loop size.

Already, data from the laboratory indicates conclusively that rule of thumb methods for applying slurry pumps are highly inaccurate. This is especially true with slurries containing a heavy concentration of solids. Each slurry appears to have its own peculiar traits which can be established only through actual test. — **Morris Machine Works, Baldwinsville, N. Y.** 242A



Timer Valve

Controls flow on timed cycle.

Timer valve now available automatically controls flow of liquids, gas or air. It turns flow on or off at desired intervals.

Unit consists of a solenoid valve and a timer control sealed in a water-tight case. It will fit all standard pipe ⅜ in. and larger, operates on 110- or 220-v. current.

Valve can be furnished in a wide variety of timing cycles. It can turn a flow either on or off, or both on and then off, at any desired time. It can perform this function each day with repeat cycle operation. Or it can provide continuous intermittent operation.—**Automatic Controls Corp., 2390 Winewood, Ann Arbor, Mich.** 244A

Centrifugal Fan

New design for top efficiency, minimum noise.

The Chicago line of centrifugal fans for a wide range of industrial applications now is built to a new design. Fans are particularly adapted for handling hot air and gases up to 600 F. They are claimed ideal for drying ovens.

Line operates at top efficiency and low noise level. A wide range of wheel diameters is available in both type B backward-curved fans and type F forward-curved fans.

Efficiency of the type B is more than 80%. It will handle volumes up to 324,960 cfm. Type F with large capacity at slow speed moves volumes up to 277,400 cfm.—**Chicago Blower Corp., 9869 Pacific Ave., Franklin Park, Ill.** 244B

Alloy Pumps

In standard line at lower cost.

A series of centrifugal pumps constructed of "high-alloy" Illium G material is now offered for immediate delivery. By introducing this line as a quantity production item, manufacturer has brought cost more in line with pumps of lower-grade stainless steel.

Illium G is a nickel-chromium-molybdenum alloy that contains 91.4% of these corrosion-resistant alloying constituents. Iron content is only 6½-7½%.—**Ampco Metal, Inc., Milwaukee, Wis.** 244C

Midget Pump

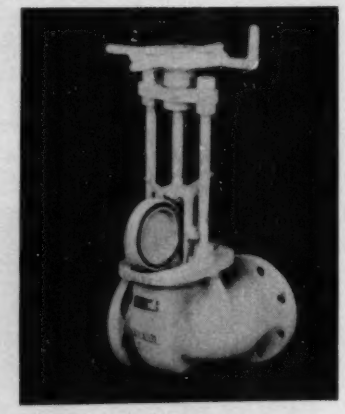
Designed for corrosive chemical service.

Midget pump is a new centrifugal pump for the chemical and process industries.

All bearings are prelubricated. Packing has been eliminated and replaced with externally adjusted mechanical seals.

Construction is particularly rugged with extra heavy shaft, bearings and non-clogging impeller. All wetted parts are made of stainless steel; other alloys are available.

Capacities range from 5 to 40 gpm. with heads from 25 to 160 ft.—**Lawrence Pumps, Inc., 371 Market St., Lawrence, Mass.** 244D



Visible-Wedge Valve

For inpenetrable sealing.

Three new visible-wedge valve styles have been added to a previous straightway model to provide all of the configurations necessary for modern piping and manifold needs.

All four models incorporate impenetrable sealing action with simplicity of operation found in a gate valve. Also, all have the same center-to-face dimensions as standard tee and elbow pipe fittings.

One glance at the valve tells you whether the line is open or closed. A precision metal-to-metal fit on the wedge and seats, augmented by dependable seal rings, provides a foolproof line shut-off. — **Hamer Valves, Inc., Box 1851, Long Beach, Calif.** 244E

TYPE 657A

Double port globe body for conventional service. Also supplied single port where tight closure required. Normally supplied in iron or steel in sizes ½" thru 12".

TYPE 657YY

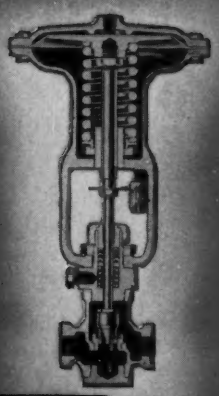
Three-way control valve for by-pass or blending service. Eliminates need for two globe type control valves. Available all castable alloys sizes ½" thru 12".

FISHER®

Has the control valve for your plant

TYPE 667Z

Split type body in which parts are readily accessible; can be economically supplied in various alloys for corrosive service. Available in flanged sizes 1" thru 2".



TYPE 510G

Small and compact bronze control valve for relatively light service. Available in screwed sizes ½" thru 2".

TYPE 657-458

Angle control valve for handling fluids containing solids, or flashing liquids which are erosive. Normally supplied in steel flanged ends in sizes 1" thru 6".

TYPE 657-SAUNDERS

Fisher operator on Saunders patented valve is widely used on "hard to handle" fluids which are viscous and/or corrosive. Available in wide variety of materials in sizes ½" thru 6".

Special design bodies for process services

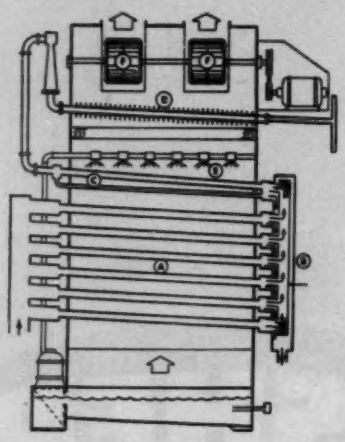
Wide selection of sizes and available in all castable alloys

Supplied with improved diaphragm operator that provides accurate valve response

FISHER GOVERNOR COMPANY • MARSHALLTOWN, IOWA

CANADIAN PLANT: WOODSTOCK, ONTARIO

LEADS THE INDUSTRY IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL



Vapor Condenser

For stripping column or vacuum kettle.

A vapor condenser has been develcped where cooling is done by evaporating moisture on the surface of tubes through which the vapors pass. Installed on top of a stripping column or above a vacuum kettle, the apparatus forms a complete, self-contained condensing system.

Heat is rejected from the coil surface directly to the outdoor air by a fan-induced air stream. Water sprayed over the coils is recirculated.

Non-condensible gases are separated from the condensate by a baffle tube within the manifold into which the condensed liquid drains. All condensate is recovered—**Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y.** 246A

Heat Exchangers

Standard units from stock.

Standard heat exchangers in sizes from 20 to 400 sq. ft. now are available from Struthers Wells for immediate delivery. Cost is relatively low because design and components have been standardized.

Available types of standard units include fixed tube sheet, floating head and U-tube units. Condensers, coolers, heaters and reboilers are supplied in single and multi-pass tube arrangements.

Exchangers are offered in a choice of carbon steel, non-ferrous alloy and Types 304 and 316 stainless alloys. Equipment meets highest construction standards, including ASME Code and TEMA Class A.—**Struthers Wells Corp., Chemical Processing Div., Warren, Pa.** 246B

Oven Burner

Designed for radiant heating tubes.

A special series of burners has been developed for heating radiant tubes in industrial furnaces and ovens.

Outstanding feature of the RT burner is a long, slow-burning flame which gives very uniform heating through a long length of tube. Gas and primary air begin combustion at the end of an alloy nozzle in secondary air stream. Air pressure at full rating is only 0.5 psi.; gas pressure even less.

Two burner sizes are available for firing at rate of 250,000 to 400,000 Btu. per hr. By using adapter castings these two sizes can be utilized to fire radiant tubes with O. D.'s from 3¾ to 8½ in.—**Eclipse Fuel Engineering Co., 1002 Buchanan St., Rockford, Ill.** 246C

Cooling Tower

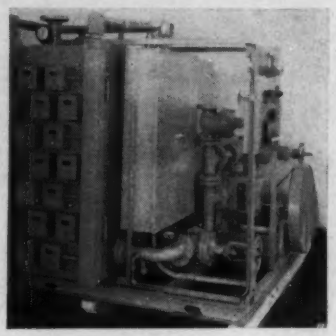
Carefully engineered for long efficient life.

A new induced-draft cooling tower offers a number of carefully worked out design details for long, efficient service.

Two-course chevron-type mist eliminator holds drift losses well below recommended minimum values. Full-cone spray nozzles constructed of plastic disperse water completely, even 30% below design flow.

Double-diamond fill racks, arranged in 3 by 6 ft. grids, break the water into multiple cascades that resist upward flow of air a minimum amount. Double-lapped sheathing panels are water tight without stagnant air spaces and resultant deterioration of wood.

Other features: all-redwood framing, simple straight-line bracing, self-leveling interior posts, shop-fabricated distribution headers and laterals, reinforced paneled fan rings.—**Foster Wheeler Corp., 165 Broadway, New York 6, N. Y.** 246D



Hot Oil Heater

Electrically heated and fully automatic.

New electrically heated, fully automatic Merrill Process Systems produce any oil temperature at low pressure within the range of 150 to 600 F. Completely assembled packaged unit is ready for immediate service when connected to tanks or kettles to be heated and to suitable electrical supply.

In most cases existing plant process vessels need undergo only minor alterations for high temperature oil heating. Pressure rarely exceeds 15 psi. so there is no need for stay-bolting jackets or installing heavy pipe coils.

Systems can be made explosion proof. They can heat individual tanks or a number of tanks requiring different temperatures. Systems can be supplied in capacities from 50,000 Btu. per hr. limited only by electrical supply.—**Parks-Cramer Co., Fitchburg, Mass.** 246E

For More Information...

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

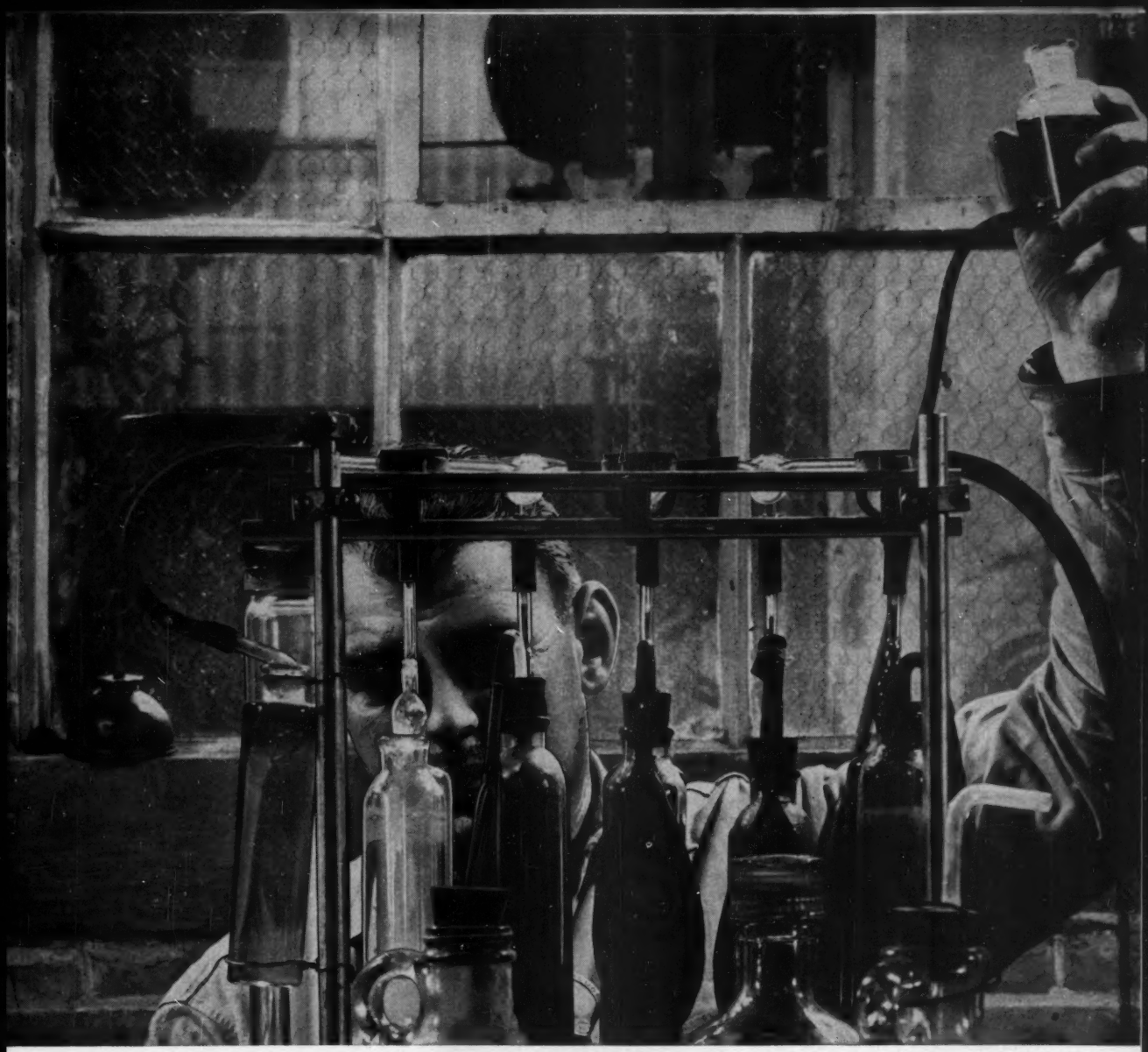


Photo courtesy Standard Oil Co., IN. JJ

boost average ratings as much as 2 octane numbers *with the LJUNGSTROM® AIR PREHEATER*

With waste heat recovered and returned to the furnace in combustion air, the most modern heat-transfer systems can be operated at peak efficiency.

That's why you boost product quality with the Ljungstrom Air Preheater. Its heat-recovery efficiency makes possible advanced furnace designs that assure remarkably close control of processing. And finer control means a more uniform product... with average ratings as much as 2 octane numbers higher. One still's added income just from higher product quality is $58,000 annually.

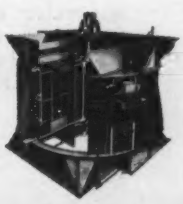
How fast is "WRITE-OFF"?

In earnings from higher octane ratings, many refiners write off the cost of the Ljungstrom installation in less than two years. This time is cut to nine months and even less, when the other Ljungstrom advantages are taken into account – saves up to 20% in fuel costs... permits more economical furnace design, with no need for convection surfaces... burns many fuels you used to throw away... results in consistently higher through-put... and minimizes slag.

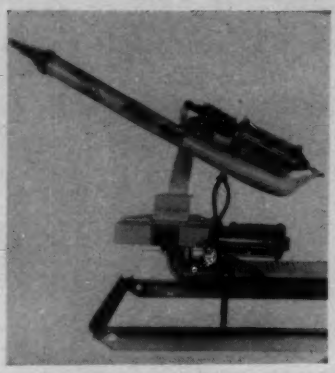
For more complete details on what the Ljungstrom Air Preheater can do for you... for an analysis of the heat recovery benefits obtainable in fuel burning equipment – call or write The Air Preheater Corporation.

Wherever You Burn Fuel, You Need Ljungstrom

The Ljundstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.



The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.



Fire Monitor

Powerful tool against plant fires.

Adapted from a hydraulic mining device, the new Intelli-Giant fire monitor discharges 2000 gpm. of water at an effective range of 300 ft. Yet, control is balanced so well that a child can adjust direction of discharge.

Device is operated by hydraulic pistons with power furnished by diverted water pressure. Within seconds the tip of nozzle can cover a horizontal travel pattern of 270 deg. and a 120 deg. verticle arc. Even with hydraulic pistons removed, the barrel can be moved with one hand because 270 deg. turn in barrel balances vector forces.

Hydraulic controls can be removed to a safe distance from fire for remote operation.

Intelli-Giant can handle water, foam or chemicals with maximum efficiency. Complete weight of unit is 650 lb. Cost is less than $1,700—**Chiksan Co., Brea, Calif.** 248A

Radiography Unit

Fully portable, fits into car trunk.

Designed for rapid inspection of welds and pipelines, the MG 260H X-ray radiography unit is sufficiently compact to fit into the trunk of an automobile.

X-ray tube and high tension generator are completely enclosed in one unit. An exceptionally fine focus provides excellent radiographic detail. Tube has 40 deg. beam and is enclosed within a shockproof, rayproof housing.

Assembly is 41½ in. long by 9 in. dia. Weight is 230 lb.—**Research & Control Instruments Div., North American Philips Co., Inc., 750 South Fulton Ave., Mt. Vernon, N. Y.** 248B

Absorbent Spreader

Three times faster than hand spreading.

Oil and grease absorbents can be spread evenly and efficiently on all types of floors by a new multi-purpose cart. As an average, the cart is said to save half the time and labor required to spread by conventional means.

Use of the cart also prevents considerable waste of absorbent. Only one application is needed to produce an even distribution. An easily accessible lever allows fingertip adjustment of distribution rate. Total capacity: 50 lb.—**Waverly Petroleum Products Co., 1724 Chestnut St., Philadelphia 3, Pa.** 248C

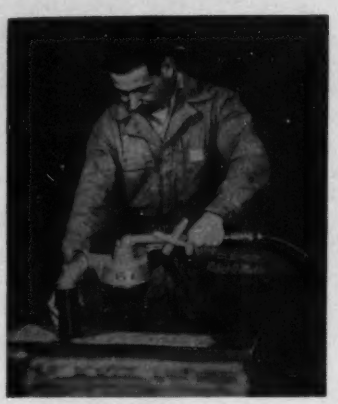
Tube Expander Drive

New features improve control.

The Torq-Air-Matic is an all-air-driven tube expander drive that offers control entirely free from the effect of operating variables and maintenance problems. Torque output is calibrated in ft.-lb. rather than arbitrary units of measurement.

By measuring torque at the output spindle the Torq-Air-Matic drive avoids over- or under-rolling. Operating variables such as motor wear, changes in quantity and viscosity of lubricants, and voltage fluctuations do not introduce any error into the torque measurement.

Device produces 14 ft.-lb. of torque at 90 psi. with 12 cfm. maximum air consumption.—**Thomas C. Wilson, Inc., 21-11 44th Ave., Long Island City, N. Y.** 248D



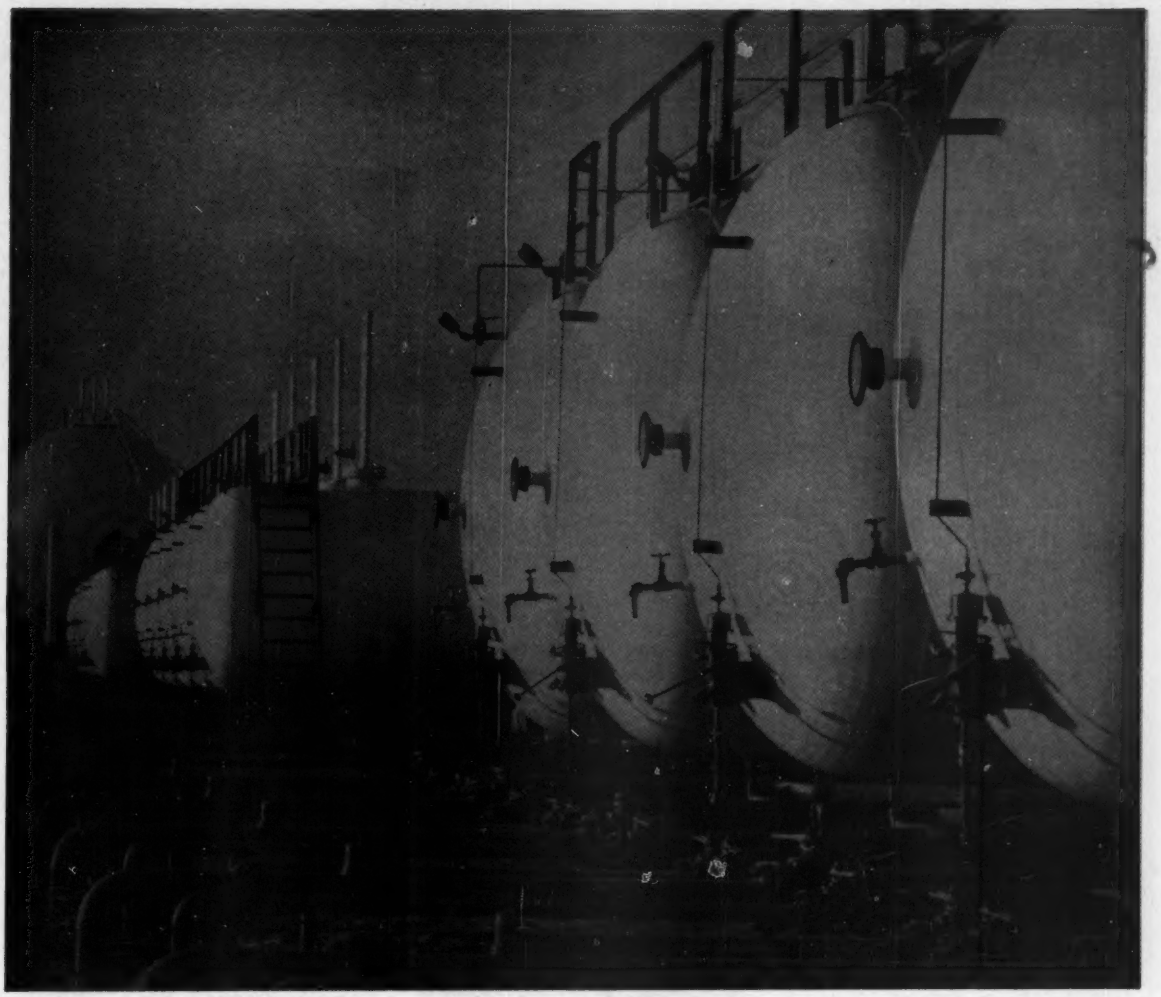
Cleaning Tool

For blast cleaning with abrasive is completely self contained.

Slow, hand cleaning of surfaces can be eliminated with the Educt-O-Matic self-contained abrasive cleaning tool. It's no larger or heavier than a small vacuum cleaner, can be used inside tanks, on ceilings, floors, cleaning before and after welding.

Educt-O-Matic is designed with a housing around the area being blasted. Within this housing, suction recovers abrasive and scoured solids. Abrasive and dust are carried into the body of the machine. Abrasive is returned to the feed hopper and dust is retained in the trap bag.

Variety of abrasives can be used. Consumption of air ranges from 33 to 60 cfm. Recommended pressure for cleaning steel is 90-100 psi.—**Clementina Ltd., 2277 Jerrold Ave., San Francisco 24, Calif.** 248E



A small part of the huge hydrocarbon storage tank farm above and below ground at Petro. Propane is stored in the cylindrical tanks, butane and natural gasoline in the bubble-shaped Hortonspheres. Additional propane is stored in man-made caverns 330 feet down.

Petrochemicals . . .

from pipeline gases

At the Petro plant—Tuscola, Illinois—an endless stream of natural gas is being separated into ethane, propane, butane and natural gasoline.

products you need

The ethane is converted into ethylene, which is in turn converted to ethyl chloride, ethyl alcohol, ether and polyethylene. U.S.I. ammonia and sulfuric acid plants next door supply and receive raw materials.

for the future

Petro can manufacture products other than these if the demand arises—products that can be made from the many raw materials available at the plant site.

in bulk quantity

Why not add this plant to your facilities? Our engineers will be glad to discuss your long-term bulk requirements for chemicals from National Petrochemicals Corporation.

NATIONAL PETRO-CHEMICALS

CORPORATION

A joint enterprise of National Distillers Products Corporation and Panhandle Eastern Pipeline Company

99 PARK AVENUE, NEW YORK 16, N. Y.

Drum Truck

Designed for loading pallets.

One operator can place heavy drums on pallets with ease when using the Ezy-Rol cart.

Shoes on the truck are placed against the edge of the pallet. Then with one easy forward motion the operator can elevate the drum to the pallet with minimum effort. Cart can also be used to lower the drum safely from the pallet.

Another feature is a spring-operated chime hook which drops over the edge of the drum or barrel as the truck is moved against the barrel. Operator doesn't have to touch either the hook or the barrel.—**Valley Craft Products, Inc., Div. of O'Neil-Irwin Mfg. Co., 770 Jefferson Ave., Lake City, Minn.** **250A**

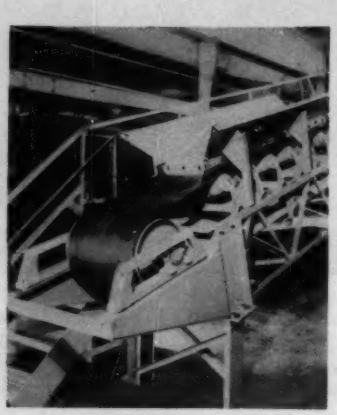
Weighing System

Is not effected by wide-range temperature change.

Reliable accuracy despite extreme temperature variation, vibration, sudden changes in load, or the presence of dust or dirt distinguish the Electro-Way system. Too, this continuous weigher for conveyor belt systems is considerably lighter, smaller and more compact than similar equipment.

The rugged dependability and high accuracy of the system are said to stem from use of a single large Ni-Span C spring, plus electronic connections. Ni-Span C, produced by H. A. Wilson Co., Union, N. J., is a constant-modulus alloy which maintains the same elasticity at all times without temperature-compensation devices.

Electro-Way's pick-up consists of a set of rollers over which the loaded belt passes. In turn, these rollers bear upon the Ni-Span C spring. A transducer converts the spring motion into an electrical signal to the electronic measuring equipment.—**Bell Automation Corp., 749 Monroe Ave., Rochester 7, N. Y.** **250B**

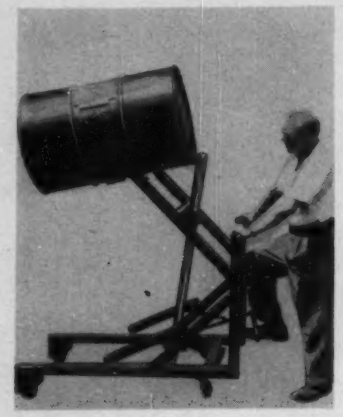


Belt Conveyors

Available in pre-engineered, standardized sections.

Pre-Bilt sectional belt conveyors in standardized, pre-engineered units are now available from nine Link-Belt plants spread across the country.

Available in capacities up to 1,500 tph. these conveyors are built in the plant nearest to the ultimate installation point. They incorporate standard components. Available belt widths are 18, 24, 30 and 36 in., with 24 and 42-in. trusses. Drives range up to 40 hp.—**Link-Belt Co., 307 North Michigan Ave., Chicago 1, Ill.** **250C**



Drum Lift

Enables one man to handle drums.

Using a new drum lift, one man can handle steel and fiber drums and carboys. Device cuts handling time and helps prevent injuries or accidents.

Lifting power is supplied by a foot-operated hydraulic jack. Drums can be raised for pouring to a height of 53 in. They may be rotated 360 deg. or stacked two high.

Lift is rated at 750 lb. capacity. Caster mounting allows drum to be moved. Brakes on the drum-lift arms hold the drum at any angle.—**Sterling, Fleischman Co., Broomall, Pa.** **250D**

Elevator-Conveyor

Improved type, costs less.

Offered as an improved continuous flow or en-masse type of elevator conveyor, the Smoothflo unit incorporates features that reduce the thrust of material against duct side walls.

Unit is self-loading, requires no feeder and can automatically proportion two differing materials, if required. It can handle flowable granular or pulverized solids which are not actively abrasive or corrosive.

The Smoothflo costs substantially less than the usual feeder and bucket elevator, it is reported. Capacity ranges from 3 to 50 tph. Speed is 30 to 60 ft. per min.—**Fairfield Engineering Co., Marion, Ohio.** **250E**

For More Information...

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Here's The Most Versatile Pilot Ever Offered!

BS&B Universal Control Pilot With Type 73-26 Instrument Air Regulator.

It's The New BS&B Universal Control Pilot

For . . . ● Temperature Control ● Pressure Control ● Liquid Level Control

FEATURES

- ✓ **Linear Response.**
- ✓ **Factory Calibration.**
- ✓ **Excellent Frequency Response.**
- ✓ **Micrometer Adjustment.**
- ✓ **Outstanding Performance Repeatability.**

This trim modern-looking weatherproof aluminum case houses the new BS&B Universal Pilot—one of the simplest, yet most versatile control pilots you've ever seen!

Only 8″ x 8″ x 4″ in size, this pilot offers a wide throttling range and high-low snap-acting settings without additional parts. Feed orifice has a push-button cleanout. All parts in the lower half of the case including the stainless steel power unit, micrometer adjusting nozzle, compensating bellows, proportioning band and gauges are common to all three types of service, and are interchangeable to reduce maintenance cost and inventory. Where regulator is required, the new BS&B 73-26 is provided to furnish a finely filtered supply of air or gas.

The pilot unit is equally adaptable to wall mounting, remote mounting, yoke or diaphragm mounting, or flush instrument board mounting. An unusual feature, designed for your convenience, is the double-hinged door which opens from either side!

For Full Details On The BS&B Universal Pilot, Contact Your BS&B Representative Or Write To . . .

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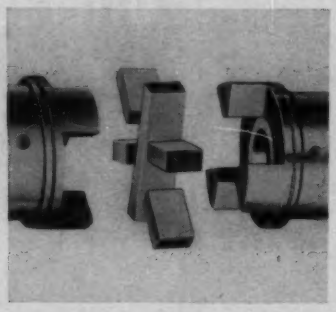


Flexible Coupling

Can be removed radially.

For centrifugal pump and similar coupling applications the new C-R coupling permits easy assembly and disassembly because it can be removed radially.

Coupling can be removed radially because special cushions are cut so that they are held in position by a standard Type C collar when the coupling is assembled. By sliding the collar the cushions can be removed easily. This allows rotation of the coupling half and connected shaft so that the intermeshing jaws slide into the stationary coupling half.—**Lovejoy Flexible Coupling Co., 4840 West Lake St., Chicago 44, Ill.** 252A

Compressor Engine

Designed to deliver increased power.

The SUTC gas-engine compressor with Turbo-Uniflo attains increased power by exhaust-powered turbocharging from startup through full load.

New operating principle based on extensive research and study incorporates timed exhaust valves. When valves open they release a pressure pulse which moves the turbine blades driving the air blower. Only through such a cam-operated, timed exhaust valve can the exhaust be opened early to completely evacuate combustion gases, and closed at the right moment to trap maximum supercharging air.

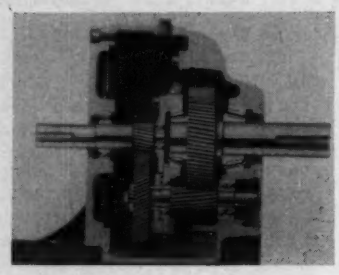
System eliminates need for power-draining extra drive on supercharger. Combination of pulse-generator ignition and chain-driven timing system is said to produce high efficiency and less maintenance.—**Worthington Corp., Harrison, New Jersey.** 252B

Wiring Conduit

Protected against destructive environment.

A tough, waterproof, synthetic cover protects Type U20SCB and U20SCG conduit against moisture, dirt, oil, fumes and chemicals. This flexible metal conduit can be used for making connections in tight places, for connecting wires on machinery that operates in excessive oil or moisture, and for applications under extreme vibration.

Type U20SCB with black synthetic cover is sized from ⅜ to ¾ in.; Type U20SCG with gray synthetic cover is available in ⅜ to 2 in. sizes. — **Universal Metal Hose Co., 2133 South Kedzie Ave., Chicago 23, Ill.** 252C



Gear Drive

For heavy in-line duty.

A completely new line of in-line helical gear drives combines standardized design with ability to withstand heavy duty service.

Drives have one-piece cast-iron housings with reliable oil seals at shaft openings to prevent oil leakage. Hardened gears produced by modern methods assure a smooth-running train. All moving parts are splash lubricated.

Double-reduction drives are built in ratios from 6.2 to 1 through 38.4 to 1 for capacities up to 118 hp. Triple reduction drives come in ratios from 47.1 to 1 through 292 to 1 with capacities up to 20 hp.—**Link-Belt Co., 307 North Michigan Ave., Chicago 1, Ill.** 252D

For More Information...

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

Emergency Light

Explosion-proof unit works instantly and automatically.

Available for the first time anywhere, an explosion-proof lighting unit provides emergency illumination. It works instantly and automatically whenever the regular source of power fails.

All electrical components are housed in approved explosion-proof equipment. Battery case contains 6-v., 60 amp.-hr. nickel-cadmium battery.

Explosion-proof heads can be mounted remotely from the unit. With two heads it will furnish approximately 7½ hr. of continuous light. — **Electric Cord Co., 195 William St., New York 38, N. Y.** 252E

Motor Control

Can perform variety of automatic functions.

Priced below $200, the Loadtrol can control remote electric motors fully and automatically. It will function on motors from 5 to 150 hp., 220 or 440 volts.

The Loadtrol reacts instantaneously to either an overload or underload current signal on both stop and start functions. Through a solenoid and a coil-activated mercury switch, the device can control a single motor or group of motors.

One application of the Loadtrol is to protect motors against the hazards of overload or underload conditions. Another is to insure the continuous full-capacity operation of feeders and similar equipment.—**Rietz Mfg. Co., Santa Rosa, Calif.** 252F

Continental's Perma-Lining gives 100% coverage plus uniform film thickness

Continental's Perma-Lined steel containers give modern protection to hard-to-hold products

Now, the 100% protection of Continental's Perma-Lined steel containers is available for chemical, paint and petroleum products. Hot-sprayed within the formed container, and fast-baked, tough enamels cover every square-inch of inner surface. Even side- and bottom-seams, often a problem, get complete, uniform coverage.

Backed by our vast experience in tailor-made packaging, Continental Perma-Linings are available for almost every chemical, paint and petroleum product. In addition, our research department is fully prepared to develop new ones for your special use.

Why not put modern Perma-Lined steel containers to work for you? Just call your Continental representative.

TAILOR-MADE PACKAGE SERVICE

STEPPED-UP STORAGE TEST. Even after prolonged storage at 100°F., polyvinyl acetate glue fails to affect Perma-Linings. Never-ending research and testing by Continental scientists assures Perma-Lined steel containers of the highest quality.

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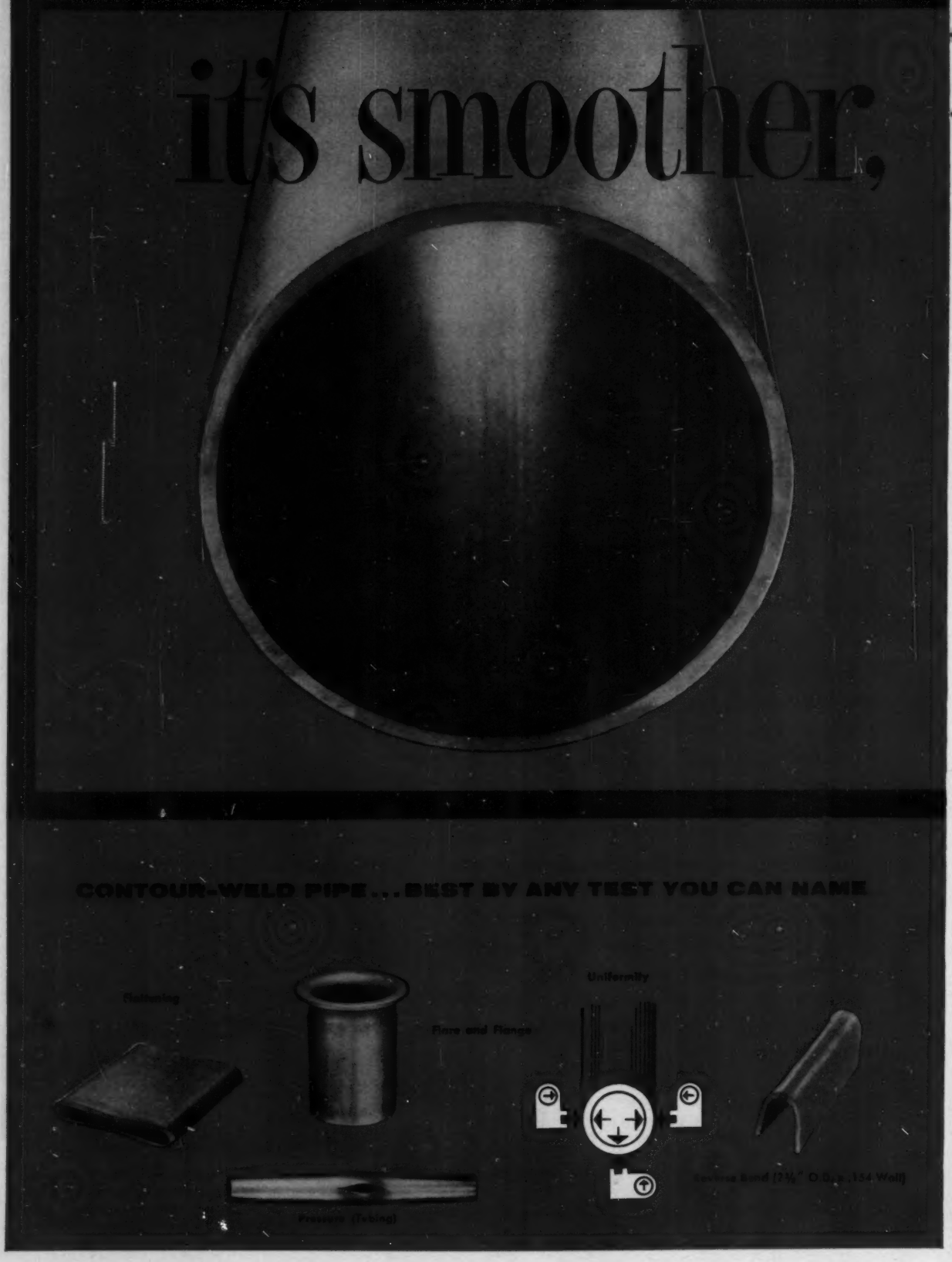
it's smoother,



stronger

...new Contour-Welded Stainless pipe completely free of bead or undercut

You can't even *feel* the weld on new TRENTWELD stainless pipe and tubing, thanks to the new, exclusive *Contour-Welding** process.

Here's How It Works *Contour-Welding*, shown in detail below, is an entirely new and patented process of making welded pipe and tubing. It results in a weld that conforms to the exact contour of the pipe. And the weld is so smooth you can't even feel it. There's never a hint of weld-bead or undercut, where corrosion or erosion can get started.

New TRENTWELD Is Better Than Ever Now you get all of the proved-best features of TRENTWELD – uniform stainless strip... wall thickness that never varies throughout the pipe or tube... curvature that's always 'in-round' – *plus* new *Contour-Welding* which extends this uniformity to the weld zone itself. What's more, Trent's superior cold-working facilities mean an even stronger pipe with smoother flared or flanged ends. Result: New TRENTWELD outperforms any other pipe, welded or not.

Put *Contour-Welded* pipe or tubing through any test you like. But the best test is your next job, especially if it's a tough one like a high-pressure hydraulic system... a line carrying corrosive chemicals . . . or high-velocity system. New TRENTWELD comes in any size or gage... and in most grades, including Hastelloy, Zirconium, Zircoloy, Titanium and 19-9-DL. You can use it with confidence – it's a product of Trent, tube mill *specialists*.

*Contour-Weld is the trade mark of the Trent Tube Company for its process of welding pipe and tubing which is protected under U.S. Patent 2,716,692.

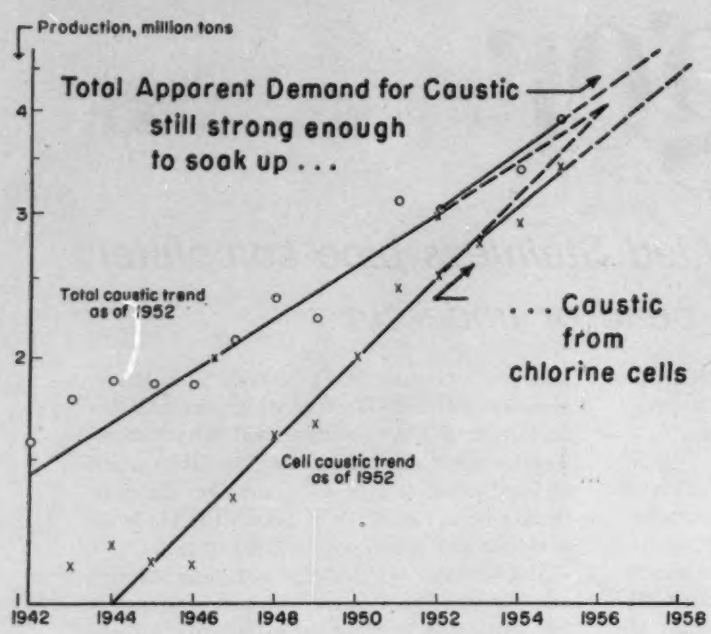
Why Trent's Exclusive *Contour-Weld* Process Means Smoother Welds...

Normally, in producing welded pipe, the weld is made at the top. But gravity plays a nasty trick. It tugs at the fluid metal in the weld zone, pulling it down toward the middle of the pipe. The result, particularly in the heavier gages, is a perceptible bulge where it hurts the most – right on the I.D. surface. If you try to get rid of the bulge – at fair cost – the metal is undercut – and corrosion and erosion start there.

But Trent put a stop to that – simply by going into partnership with gravity. With their exclusive *Contour-Welding* process, they weld at the bottom – and gravity works for them. For then, the bulge is in the opposite direction – blending in perfectly with the contour of the pipe itself.

TRENTWELD **STAINLESS STEEL TUBING**

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)



Keeping a Dynamic Balance

Chlorine output, mounting over the years, was figured by some to sate markets with electrolytic NaOH. But industry is grabbing all the caustic that comes along.

Cecil H. Chilton, Senior Associate Editor

Threat of a glutted market for caustic soda has long hung over the chlorine industry. Some market researchers have predicted that by now the rising output of chlorine-accompanying electrolytic NaOH would match the total demand for all caustic. As a corollary to this, lime-soda caustic would be out of a job and chlorine-makers, were they to expand further, would have tough-to-sell caustic soda running out their ears.*

This theory has been at least temporarily debunked recently, with the caustic "saturation point" deferred for some time, if not indefinitely. For while 1955 output of chlorine jumped 18% over 1954, to 3.41 million tons, total caustic soda production (and, most importantly, its demand) broke records of its own in tallying 3.90 million tons, 15% more than 1954.

And while lime-soda caustic slipped a bit, it stubbornly clings to about the same slice of the market—half a million tons—it had twenty years ago.

▶**Healthy Balance**—New electrolytic cell capacity coming in within the next year or two may upset the balance for a while, with chlorine in slight excess and caustic in greater excess. But with supply and demand for both chemicals being so closely balanced as of the first quarter of this year, a little more capacity shouldn't bring about a serious oversupply.

Here are some of the factors tending to keep chlorine and caustic demands in approximate balance these days:

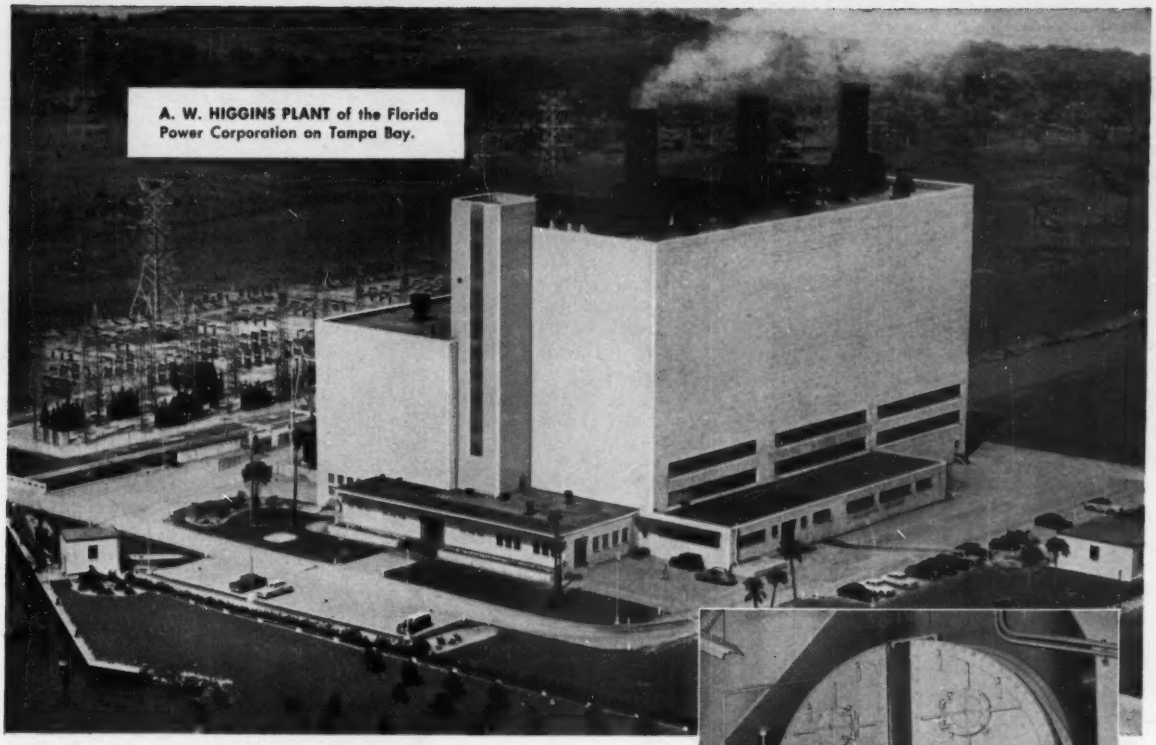
- Viscose industry, biggest user of caustic soda, has waxed greatly, particularly in production of rayon staple, high-tenacity tire cord and cellophane.
- NaOH is nibbling at soda ash's dominant position in the aluminum industry. It's used to get the severer digestion conditions needed for more refractory grades of bauxite.
- Dow is converting NaOH into Na_2CO_3 in a new unit which started up last fall at Freeport, Tex.
- Lime-soda caustic provides a degree of flexibility in the chlorine-caustic balance.
- A portion of new mercury cell capacity is now turning out KOH rather than NaOH.
- A strengthening market for sodium is providing more chlorine without caustic.
- While caustic demand by the pulp and paper industry remains strong, chlorine's leading position as a pulp-bleaching agent is threatened by other chemicals, notably chlorine dioxide (made from sodium chlorate).
- Recent expansions in the production of some large volume organics—like ethylene glycol and phenol—have favored process routes which don't consume chlorine.
- Anticipated big outlet for chlorine in the production of titanium metal has failed to materialize.
- Byproduct HCl use continues to grow at the expense of HCl made by burning chlorine.

▶**Growing Capacity**—Plans for new production capacity point up the optimistic outlook for the long-term future.

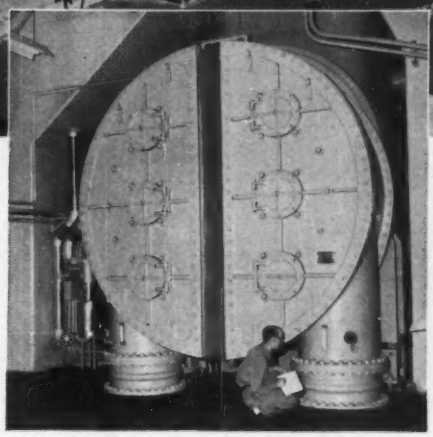
Prominent in these plans is the Baton Rouge area. Wyandotte, Dow and Kaiser are figuring on new chlorine-caustic plants there. Columbia-Southern is upping capacity at nearby Lake Charles.

Kaiser will consume its own caustic production in process-

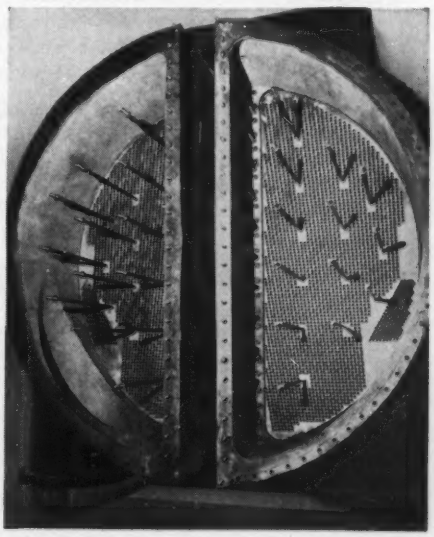
*Better than 90% of domestic chlorine stems from the electrolysis of brine and is accompanied by 1.13 times its weight in caustic soda. This electrolytic NaOH now comprises 88% of the total caustic soda produced (the balance comes from the lime-soda process).



A. W. HIGGINS PLANT of the Florida Power Corporation on Tampa Bay.



Exterior view of one of the condensers in the Higgins plant, and below, one of the three condensers ready for tubing. Condensers made by C. H. Wheeler Mfg. Co., Philadelphia, Pa.



REVERE 10% CUPRO-NICKEL SOLVES CORROSION PROBLEM FOR FLORIDA POWER CORPORATION

About six years ago the Florida Power Corporation was experiencing condenser tube failure at its Bayboro plant in St. Petersburg. Revere's Technical Advisory Service was called in, and recommended replacing the failed tubes with 10% Cupro-Nickel, which has a marked resistance to corrosion from brackish water. This recommendation proved successful. As a result, when Florida Power planned to add a new 135,000 KW plant, named after A. W. Higgins, Revere 10% Cupro-Nickel tubes were specified. All three units in the new plant are thus tubed. The tubes are 7/8" OD x 18 BWG, 24' 7" long. A few spares are kept on hand for possible replacement, but with regular cleaning to remove debris (small bits of shell, etc.), the tube life has been exceptional, thus adding to economy of operation and increased service to a fast-growing area. . . . If you have questions regarding condenser tube selection and service, get in touch with the nearest Revere Sales Office. Remember to specify Revere.

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ing bauxite to alumina, says it will sell the chlorine (probably through a merchant producer).

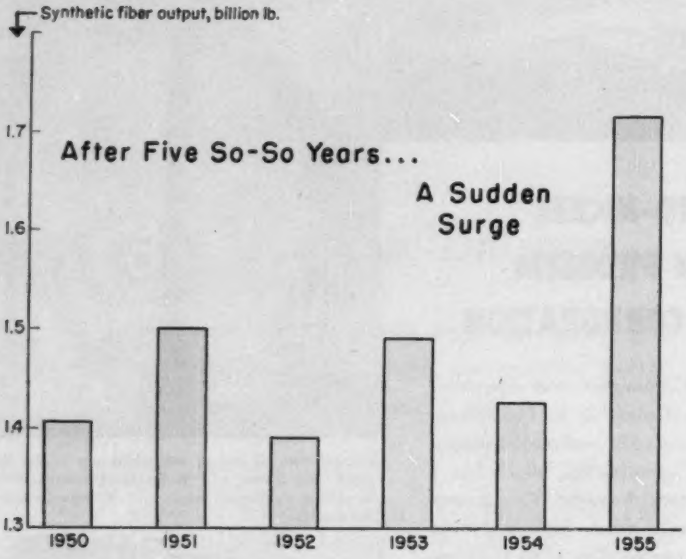
Other new capacity under construction is oriented towards the pulp and paper market—Solvay at Brunswick, Ga., Hooker at Vancouver, B. C., and Weyerhaeuser at Longview, Wash.

▶**Growing Markets**—Heaviest underwriter of the present and future standing of the caustic-chlorine business is the continued growth in such substantial industries as pulp and paper, plastics, refrigerants, solvents and insecticides.

In the plastics field, one of the promising growth markets for chlorine is in the production of polyurethanes. Chlorine goes into the phosgenation reaction to make the isocyanates.

In the aluminum industry, synthetic cryolite is challenging natural cryolite. Each ton of the synthetic product consumes about 1,500 lb. of caustic soda in its manufacture.

Many of the problems delaying large-scale use of titanium have been solved (*Chem. Eng.*, April 1955, p. 262). Thus production of the metal should soon call for more chlorine.



Synthetic Fibers Shine Again

After five lackluster years, man-made fiber production set a glossy new record last year. And '56 will glow even more brightly.

Hugh T. Sharp, Assistant Editor

Sparked by market-broadening newcomers, the man-made fiber industry is rushing to another record year. Look for production to paste a 5-10% increase atop 1955's record-shattering 1.72-billion-lb. total.

Heartened by last year's rapid climb to the new mark, which came after five relatively static years, synthetic fiber producers plan to boost capacity by over 100 million lb. this year.

▶**Out of the Doldrums**—Hindered by a general business slump and a consumer preference for durable goods, synthetic fibers—and the whole textile industry—made little headway from 1950 through 1954. Man-made fiber production hovered around the 1.45 million-lb.-a-year mark. Per capita consumption slipped from 1950's peak of 9.2 lb. to 1954's 8.2 lb.

Then last year's production, 20% above 1954's, brought memories of the '40's when such yearly production increases were common.

Part of the stepped-up production last year, particularly in the early months, went to building up mill inventories pared in 1954. But a strong demand throughout the economy was the major factor contributing to the rise.

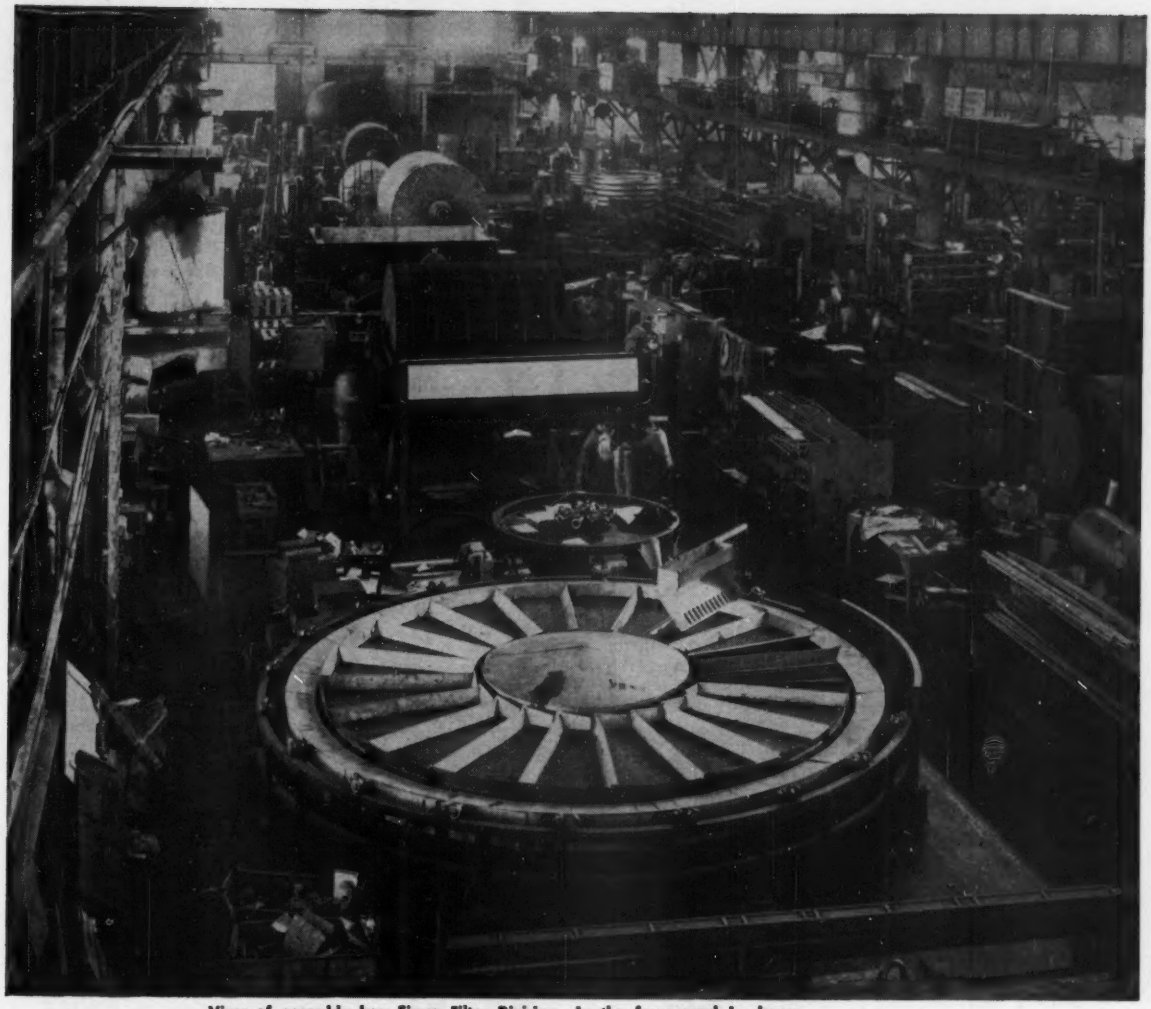
Most significantly, per capita consumption shot up again—to 10.5 lb. This is the highest ever for man-made fibers. If consumption remains firm through this year another record is in sight.

▶**Slight Pall**—Only two shadows lie in the path of the individual fibers. One is cast by the new fibers which keep coming into the market place, bidding for a share. The effect of most of these newcomers has been to broaden the entire market for synthetics by tackling new jobs or filling in some of the gaps in the fiber spectrum. But inevitably there has been competition between fibers and realignments in end-use patterns.

The other shadow leads from the properties of the fibers themselves. Man-made fibers exhibit some fairly wondrous properties—though hardly deserving to be called "miraculous." Ease of care and durability are perhaps the prime assets.

But balanced against these are low moisture pickup and discomfort in hot weather, poor electrostatic properties, resistance to some dyes, need for low temperature in washing and ironing, and the tendency of some to "pill" or "fuzz."

▶**Consumer Skepticism**—These latter properties have already created some consumer resist-



View of assembly bay Eimco Filter Division. In the foreground is shown 120 sq. ft. pan filter, all stainless steel construction for phosphoric acid.

SPECIFY EIMCO FILTERS FOR GUARANTEED PERFOMANCE

Eimco filters are built to meet the exacting requirements of process engineers all over the world.

The wide range in types of filters available at EIMCO include both vacuum and pressure designs in: Drums, Discs, Agidiscs, Top Feed, Dewaterers and Dryers, Pans, Tubular elements and Plate and frames. Each of these designs is available with numerous attachments for cake dewatering and cake removal. Materials of construction are selected with regard to the material to be filtered.

Every filter job receives individual attention at Eimco. The Eimco filter delivered in your plant provides you with the finest filtration equipment you can buy at any price and with a machine guaranteed to perform on your product.

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EIMCO

B-175

ance toward the synthetics, especially when a fiber has been over-promoted. The consumer learned quickly that "wash 'n' wear" fabrics — completely washable and needing no ironing—just aren't. They may have needed no ironing in the lab, but after being made into a suit or dress the fabrics just haven't stood up to the claims. This has forced several firms to change their advertising tune to "little or no ironing" with the emphasis on the "little."

But despite the shadows you can look for the positive virtues of these fibers to increase their market standing. Technical progress will likely remove or diminish many of the handicaps at the same time. Or new fibers will be developed to skirt the drawbacks completely. In any event, despite a slow start for rayon, man-made fibers will probably beat last year's record by a healthy margin this year.

By midyear, fiber makers will have boosted the industry's capacity to 2.25 billion lb., well on the way to the 2.38 billion lb. to be installed by the fall of 1957. This compares to last November's 2.15 billion lb. of capacity.

▶**Noncellulosics Move Fastest**—Percentagewise, the noncellulosic fibers—including acrylics, protein, polyamides, polyesters, polyethylene, polyvinyl acetate, polyvinylidene chlorides, dinitriles and several other types of fibers—will get the biggest increase, over 20% between the end of '55 and the end of '57. Growth record of these fibers has been outstanding—today's production is about three times that of 1950.

Last year production of the noncellulosic fibers was 457.4 million lb. of which 78.2 million represents textile glass fibers. Nylon fiber production, the biggest factor in this group, is currently estimated at just over 290 million lb. Acrylic fiber production is a distant second at an estimated 80 million lb. Dacron polyester, and saran lead the rest of the pack.

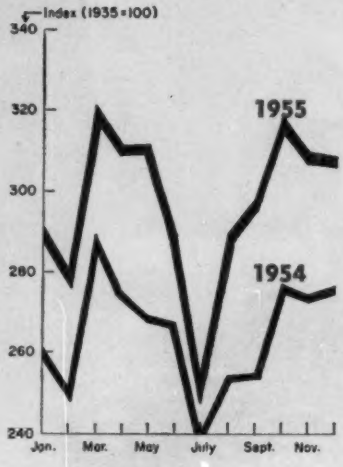
Blends of these fibers with each other and with cottons and wool will make strong contributions to raising the total.

▶**Stronger Cellulosics** — With the cellulosics, rayon and acetate, high tenacity rayon yarns racked up the biggest gains last year. Production climbed from 339.1 million lb. in 1954 to 432.7 million lb. Regular rayon yarns rose from 169.8 million lb. in '54 to 202.3 million lb. last year.

Acetate yarn climbed 16½% to 230.1 million lb. Acetate makers view this upturn as the beginning of a swing back to luxurious acetate fabrics. For several years the trend has been to more casual wear. They feel that the extreme has been reached in this and that the future tendency will be toward "dressier" dressing.

A more important trend is toward industrial uses. Some fibers like Cyanamid's Fortisan-36, DuPont's Type 272 rayon, Allied's Caprolan and others were tailored for industrial uses from the research stage.

Chemical Consumption



Consumption by Industries

	Dec. (Final)	Jan. (Est.)
Fertilizer	77.28	84.99
Pulp & Paper	34.40	38.04
Petroleum refining	31.36	32.27
Iron & Steel	19.27	19.86
Rayon	32.05	32.40
Glass	23.02	24.82
Paint & varnish	24.35	30.74
Textiles	10.27	11.18
Coal products	12.48	11.85
Leather	4.29	4.33
Explosives	9.16	9.36
Rubber	7.02	7.49
Plastics	23.92	24.23
Total	308.87	331.56

Now's the Time to Cut Your Unit Costs

It's the firm opinion of many that the nation's economy is nearing, or is already riding, a crest. Professor Erwin Schell of MIT urges industry to act now, before a possible decline, to prevent a normal relaxation of a hectic business pace from becoming something serious. Act positively now to consolidate your gains and build staying power in your industry, says Schell.

At the annual meeting of the Assn. of American Soap & Glycerine Producers, Prof. Schell outlined some of the main avenues to one of industry's most potent decline-easing weapons —unit-cost reduction.

▶**Increasing Volume** — Nothing reduces unit production costs more markedly than does increase in volume, for it is this enlargement which affords greater latitude for distribution of fixed and semi-fixed overhead. Says Schell, "It is of the greatest importance during the changes which lie ahead that companies be in position to produce reliably, steadily and at close to top capacity."

Now is the time to concentrate on maintenance programs to insure reliable full-scale operation. Now is *not* the time, according to Schell, to invest capital in new facilities and equipment, for price and service will tend to become more favorable soon. Prof. Schell concedes, though, that pressure of competition may make building of new capacity imperative without delay.

▶**Procurement Economies**—As industrial activity declines, emphasis in procurement of raw materials must be on price rather than on delivery. Schell envisions purchasing agents taking suitcases in hand to search the raw materials markets for lower-priced commodities. In the chemical industry where raw material costs are such a large contributor to to-

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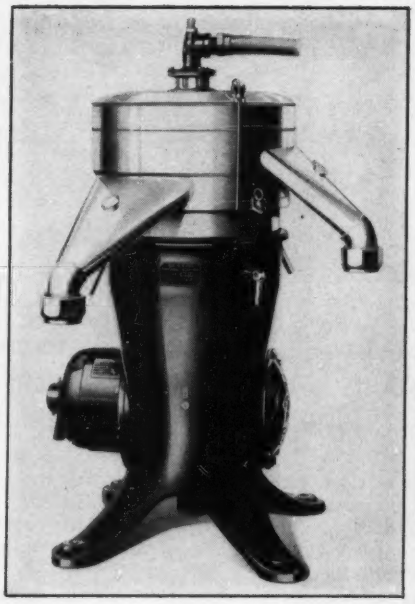

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tal costs, savings in purchasing will immediately help reduce unit-costs.

▶ **Value Analysis**—Prof. Schell defines this as the determination of the optimum quality of a component called for in terms of the commercial characteristics of the product as a whole. Value analysis may surprise the processor by showing him where components or ingredients have specifications calling for much higher quality than is necessary or even desirable.

Schell cities an example: a spring made from a costly alloy steel, with a life of 40-50 yr., was being used to actuate the door of a refrigerator having a useful life of but 10-15 yr.

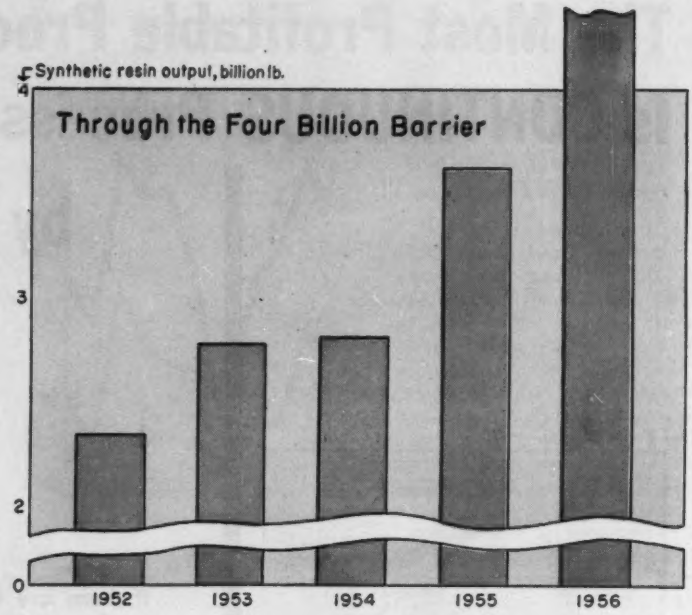
▶ **Methods Analysis**—Chemical and allied industries have been called an unfertile field for analysis and improvement of methods and processes. The argument has been that any change in completely balanced procedures may reflect harmfully in the remainder of the process.

Schell thinks otherwise, thinks that the cost savings possible through methods analysis —obtainable often at small or moderate capital investment— are too great for chemical companies to ignore

Some examples of unorthodox unit-cost savings: Use of fixed binoculars at ground levels to read gauges mounted at considerable height; elimination of building walls and partitions in areas without severe winters.

▶ **Strengthening Morale**—Schell advises encouraging employees more and more to contribute their thought and imagination to improvement of their work. This will counterbalance the concern over employment security which lowers work effectiveness in times of uncertainty. And it will doubtless uncover opportunities for cost reduction —and a strengthening of the company's competitive resources —as business activity moves downward.

Schell feels we are fast entering a period when employees are especially concerned over the economy and at the same time unusually eager to collaborate with management in improving a company's position.



Plastics in '56: 4 Billion

A year ago it didn't seem possible so soon. But the 800 million lb. production surge in 1955 makes 4 billion lb. of plastics this year a near-cinch.

Not much more than a year ago most authorities predicted modest increases in production of plastics and resin materials in 1955. Volume was pegged at slightly over three billion lb., compared to 2.8 billion lb. in 1954.

But plastics prophets reckoned without (and who didn't) the explosive force of the national economy. In keeping pace with this economy last year, plastics output reached instead an astounding 3.6 billion lb., according to estimates by the Society of the Plastics Industry. This was nearly 30% above 1954's mark and 340% better than production at the end of 1945.

And present consensus seems to be that this year will see an outpouring of four billion lb. of plastics and resin materials.

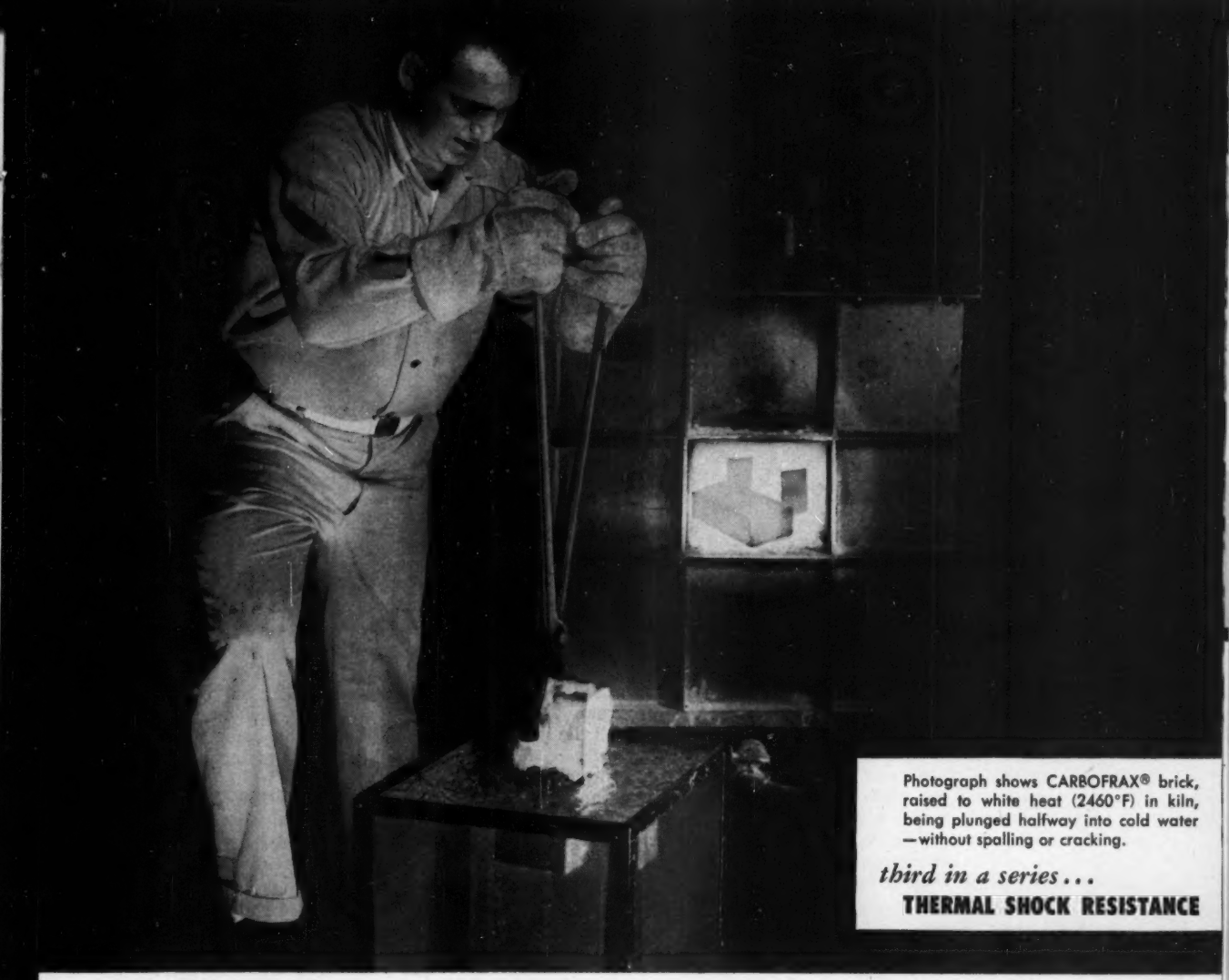
Let's look at some of the plastic products that are expected to lead the way to this new record—cellular plastics, reinforced plastics and plastic piping.

• U. S. Rubber Co. officials estimate the volume of cellular plastics will go up two to three times over 1955, even though these materials are still in the development stage.

• Statistics of the reinforced plastics industry are traditionally based on the use of polyester resins. The SPI estimate of 1956 production of these resins is 73 million lb. compared with 49 million last year.

• One large producer of plastic pipe forecasts a 25% rise in output this year. Another puts it at 10%.

▶ **Thermosets**—1955 emerges as the big comeback year for the thermosetting resins, with production making up most of 1954's loss.



Photograph shows CARBOFRAX® brick, raised to white heat (2460°F) in kiln, being plunged halfway into cold water —without spalling or cracking.

third in a series . . .

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The current issue of Carborundum's magazine "Refractories" features a comprehensive article on heat shock. It may offer suggestions helpful to you in handling a condition of this nature. Send for your copy today.

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Production of Plastics and Resin Materials (Pounds)*

	1954	1955
Vinyl resins	516,630,000	698,083,000
Styrene resins	501,570,000	616,569,000
Alkyd resins	355,000,000	435,000,000
Phenolic, other tar-acid resins	396,610,000	524,920,000
Polyethylene	195,000,000	390,000,000
Urea and melamine resins	253,280,000	313,031,000
Coumarone-indene, petroleum polymer resins	220,000,000	259,632,000
Cellulose plastics	123,230,000	144,757,000
Polyester resins	27,000,000†	54,831,000

*U. S. Tariff Commission, U. S. Dept. of Commerce.
†SPI estimate.

Factors in the comeback: Rapidly-expanding use of melamine dishware and buttons; improved moldability of urea and melamine; acceptance of alkyd molding compounds as general purpose materials in electrical applications; and new general-purpose, fast-curing phenolics.

▶**Polyethylene** — Production rose last year more than 70% to an estimated 400 million lb. With a dozen companies in the field now compared to but two in 1954, estimated capacity by the end of this year is figured at 600 million lb.

Film sales almost doubled in 1955. Use of polyethylene pipe for farm water supply increased substantially.

Although some of the new capacity is committed to the promising new low-pressure material, don't look for this type of polyethylene to be available in large quantities before 1957.

▶**Vinyls** — At long last, vinyl film is being used where it should be used, and where its properties can really show off to advantage. The film is becoming an established material for raincoats, shower curtains, etc., and has grown popular for many agricultural and industrial uses. Laminations of vinyl film and sheeting with textiles represent an area of great expansion during 1955.

Floor covering and wire covering, continuing to expand rapidly, made the largest gains.

Unicellular polyvinyl chloride in the expanded form is finding greatly increased markets in flotation and shock absorption applications, as well as in insulation for clothing.

▶**Polystyrene**—Use of styrene plastic for refrigerator parts—by far the plastic's biggest outlet—picked up quite a bit in 1955.

With remodeling of homes being encouraged by the government's "Operation Home Improvement" program, the outlook for plastic wall tile is especially promising.

▶**Acrylics** — Acrylic sheet for signs, glazing and lighting made substantial headway during 1955. Autos consumed huge quantities of the molding material.

▶**Reinforced Plastics**—1955 saw more use of raw materials other than polyesters, as epoxies, low-pressure phenolics, melamines, silicones and fluorocarbons got into the act.

There's also been an increase in the kinds of reinforcements used. Synthetic fibers, like acrylic and polyester, have been found practical.

Principal reasons for reinforced plastics' growth: High strength-weight ratio; good chemical, mechanical and electrical properties; ability to be molded at low pressure, in large sizes and in complicated shapes; and great military significance (missiles, landing craft, body armor, assault boats, airplane parts, etc.).

▶**Technique to Watch**—Weakest point in plastic fabrication is thought by some to be the time factor. Now there is a technique (not yet applied to volume production) which permits plastic parts to be turned out just as fast as in any metal stamping operation. The effect on production costs is obvious.

Called super-cooling, this method is based on the property possessed by numerous plastics of remaining easily-formable for several hours to a day following sudden quenching.

Chemical Raw Materials —Make 'Em or Buy 'Em?

A chemical company must base a decision to manufacture its own raw materials on a most careful evaluation of the return on the investment. This is the most important criterion in the make-or-buy decision. At worst, the return should equal the average of the industry operating in the same area.

That's the gist of a talk given by Reichold's Theodore Hodgins at a recent Commercial Chemical Development Assn. meeting. Hodgins went on to outline the major considerations that go into an economical evaluation of raw material production:

Volume Needed—Manufacture of the raw material must always be on a scale large enough to be economical and yet not so large as to produce a surplus, the disposal of which would require new marketing facilities and staff. Although immediate volume requirements don't have to match the economical minimum, company demand a few years hence should.

External Supply—A company must assay present and future outside sources of the raw material to see if this capacity will be sufficient to cover the needs of the growth-and-use pattern drawn up by the market research group.

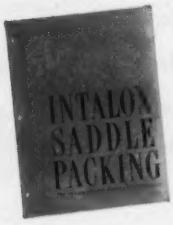
Logistics—A specific analysis should be made of the use of the raw material at each of the company plants and the freight rates from predetermined points. This study will help pinpoint the most economical location for a raw materials plant from the standpoint of materials movement. Of course this "ideal" shipping location must be balanced against the optimum plant site based on power costs, raw material availability (raw materials for the ultimate raw material) and other factors personal to the raw materials plant.

INTALOX SADDLE PACKING

In the five years since Intalox saddle packing was first presented to chemical engineers as a uniquely new and different tower filling material, it has earned widespread acceptance.

Its better HTU values has permitted reduced tower heights resulting in savings in construction costs; its lower pressure drop has permitted savings in initial investment in blowers and pumps and substantial reduction in operating costs; its higher flooding limits have permitted higher liquid and gas rates.

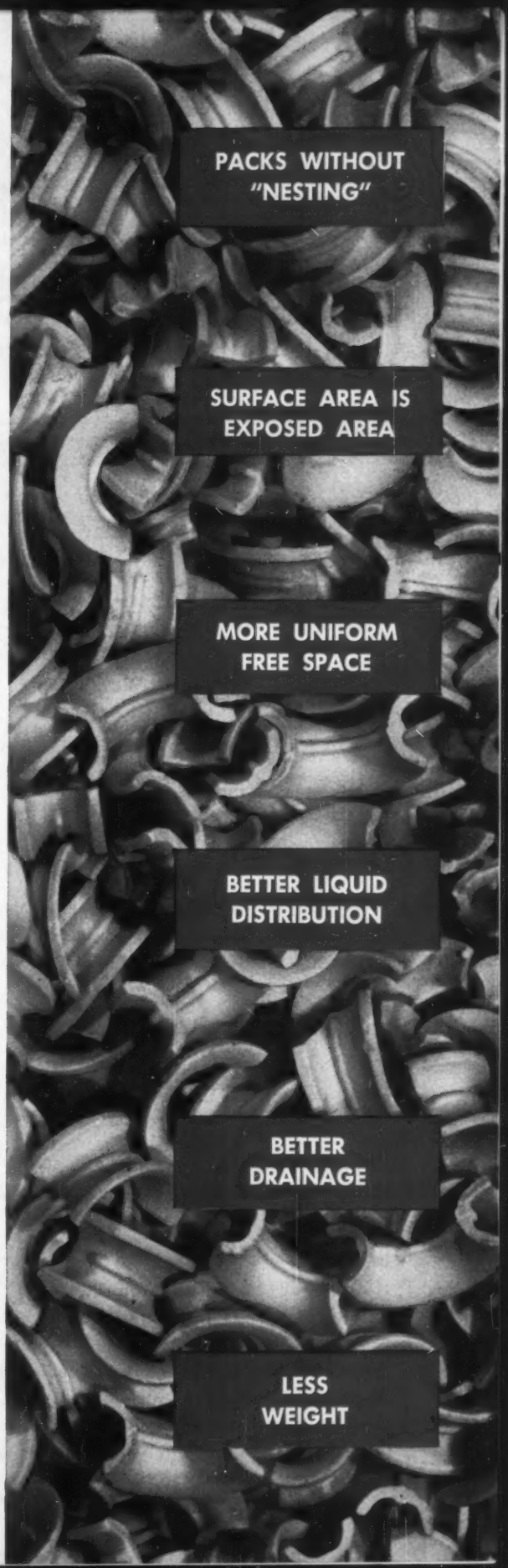
This improved performance stems from the unique, patented shape of Intalox — a shape which makes possible maximum contact area between liquid and gas with minimum resistance to gas flow. A comparison of published data shows that size for size, Intalox offers: a greater number of pieces per cubic foot, a greater total surface area per cubic foot, a higher percentage of free space and less weight. Of even more importance than the greater physical surface area offered by Intalox is the fact that virtually all of the greater area is *accessible* surface area. For no two pieces of Intalox can "nest" to render ineffective any significant portion of the packing.



Intalox saddle packing is manufactured in white chemical porcelain and in chemical stoneware. It is made in six nominal sizes: ¼", ½", ¾", 1", 1½" and 2". Full technical data is given in Bulletin S-29, free on request.

U. S. STONEWARE

AKRON 9, OHIO



ECONOMICS . . .

Corporate Policy—Raw material procurement must be viewed in the light of horizontal and vertical integration. Hodgins poses this question: "Is it better long-range-wise to build more facilities for the production of polymers and plastics, or is it better to integrate vertically to produce the raw materials for the existent and substantially vertical organization?"

As to vertical integration upward—toward the consumer—Hodgins says a chemical concern must decide whether its best interests are served by moving into consumer products fields with all their elaborate merchandising and marketing problems. Or whether it might be better off to remain a supplier to other industries.

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Modular Heat Exchangers . . . . . **July**

Graphical Design for Liquid-Solid Extraction . . . **Aug.**

New vinyl acetate entry

Attracted by the golden purses offered, still another outfit has entered the booming vinyl acetate sweepstakes. Air Reduction's entry, a 30 million lb./yr. plant, is a modification of the German Wacker process. (p. 288)

Your letters let us know!

Welcomed by the Editor, our readers' views sweep wide range of topics, add another dimension to our coverage. (p. 307)

New technical literature!

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● Manufacturing ●● Manufacturing and product development ●●● Manufacturing, product development and research ○●● Pilot manufacturing, product development and research

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	GPE CAPACITIES
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	●●●		□●●				●●	●●●	●●●		●●●		Motion Picture and Audio Equipment
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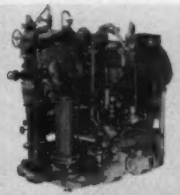
●●●			●●●	●●●	●●●	●●●				●●●		●●●	SYSTEMS ENGINEERING

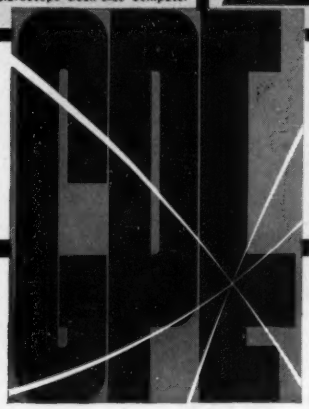
Librascope Desk-Size Computer

GPL Industrial-Institutional TV System



Griscom-Russell Shipboard Distilling Plant

Askania Electro-Jet Power Package



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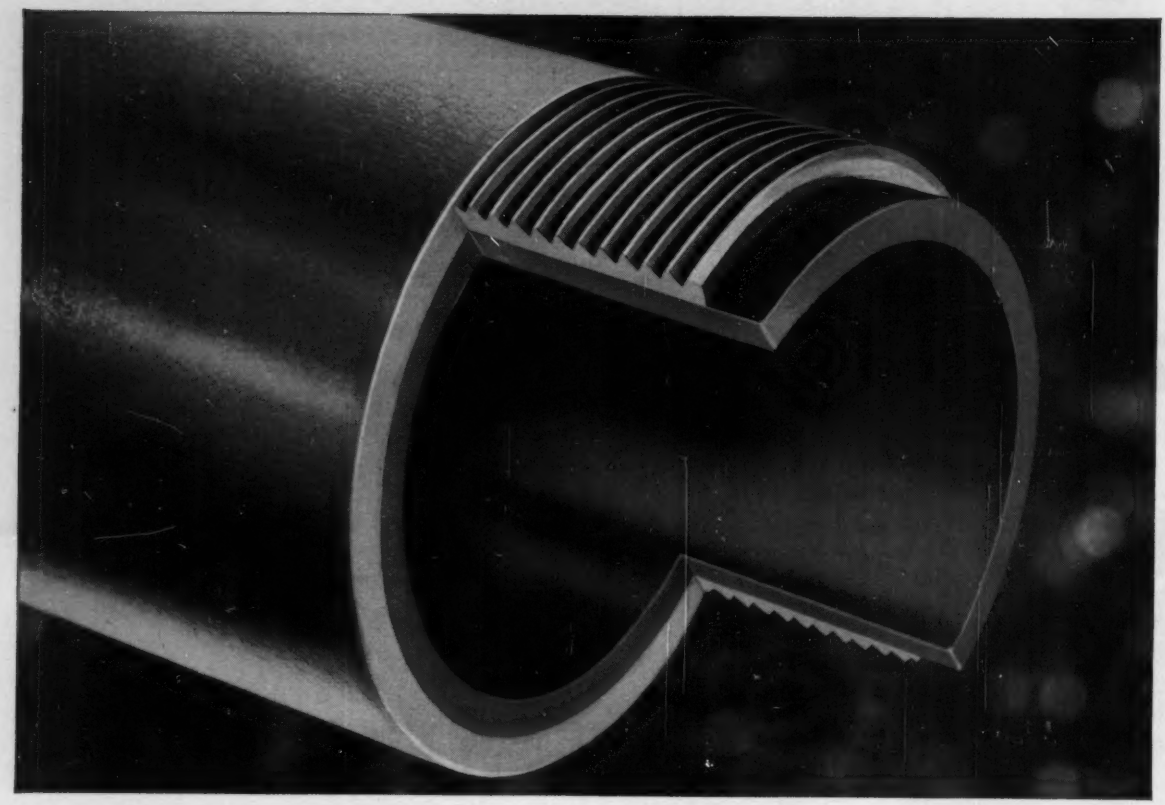

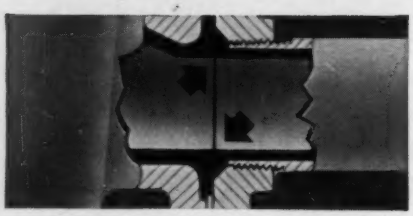

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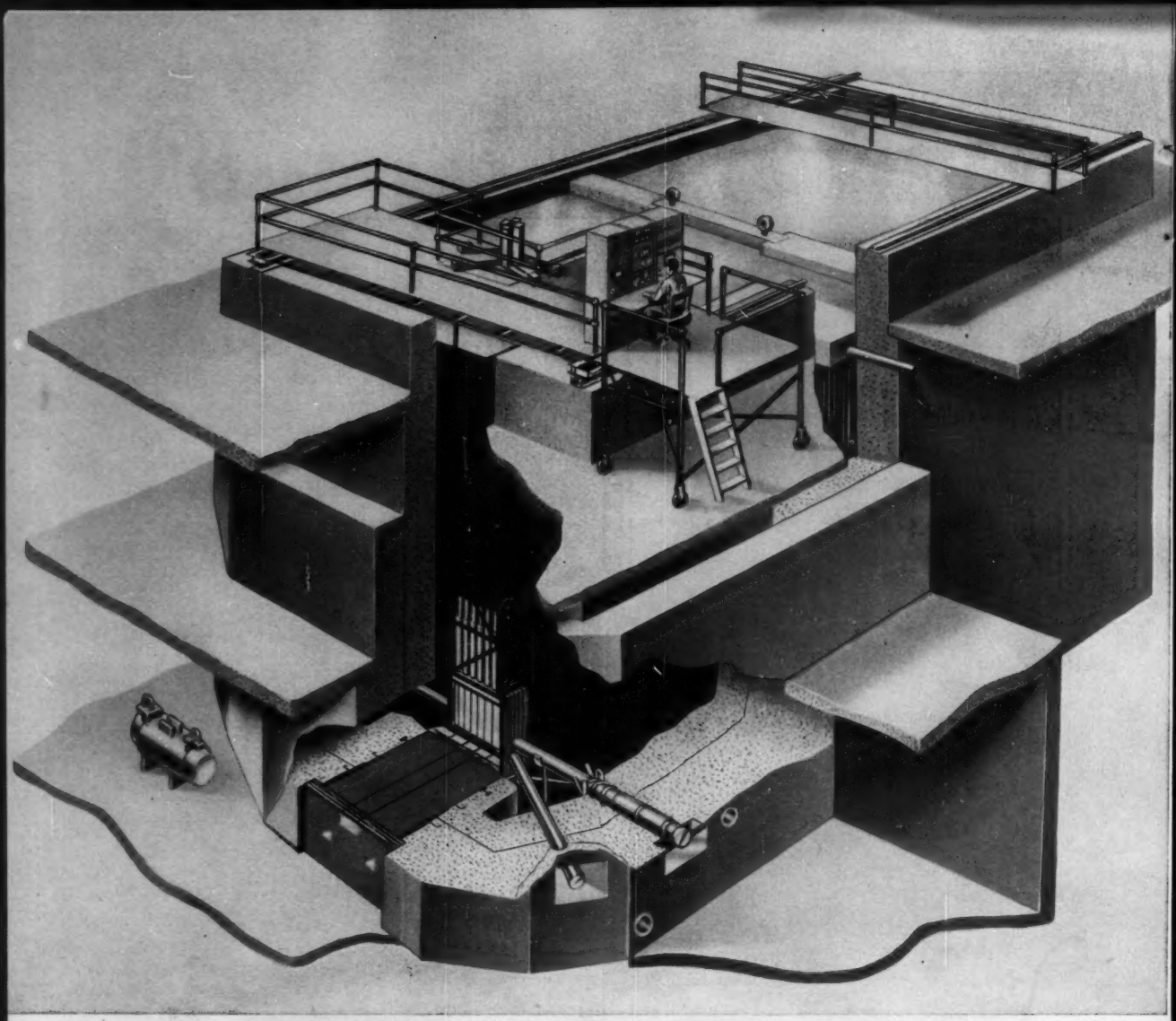

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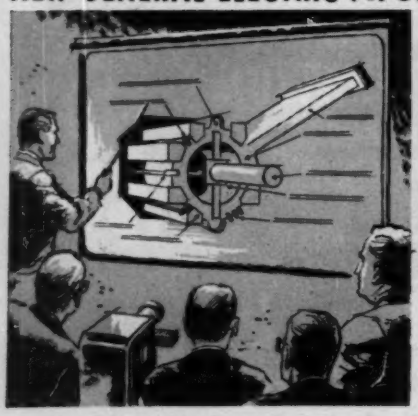

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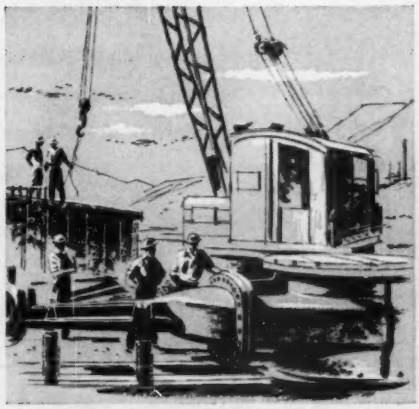

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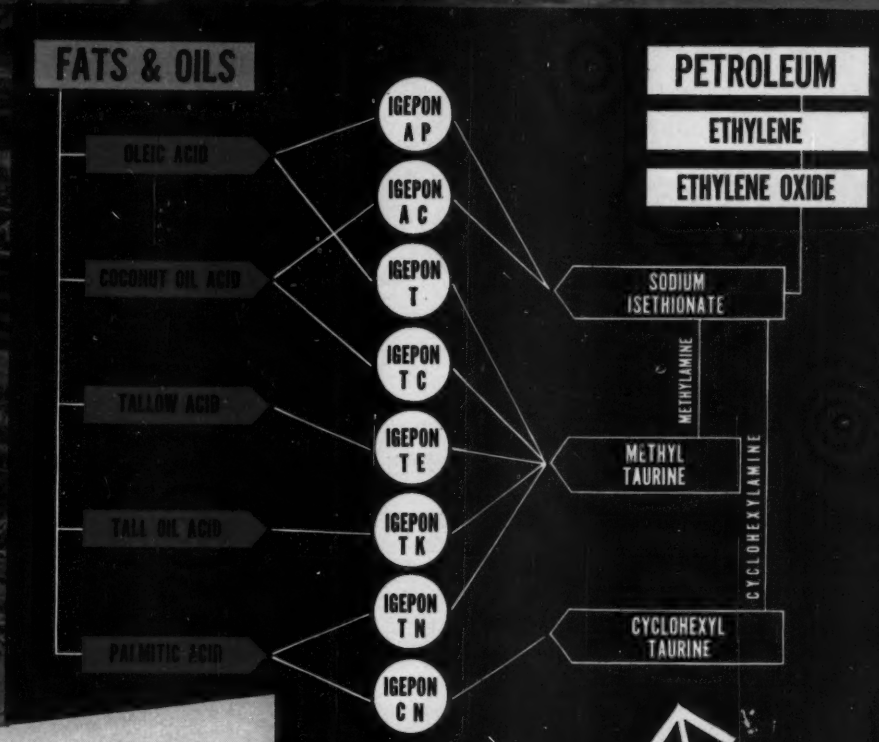


No other surfactants equal the performance and versatility of Igepons

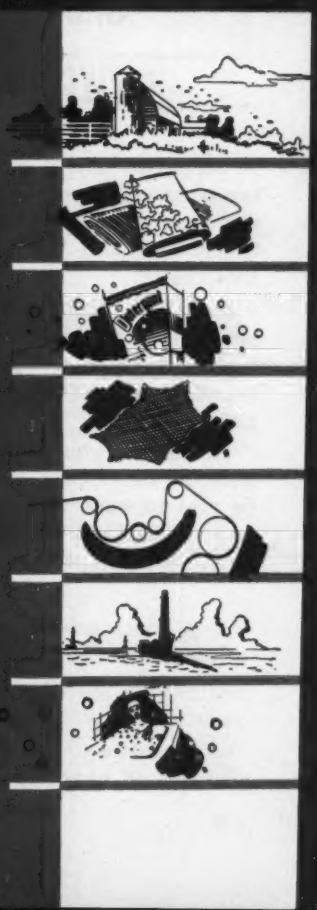
Chemical Derivation of Igepon

There are 8 basic Igepons, each supplied in various concentrations and physical forms, and there is one to do the job for you.

Igepons are important in many industries, including cosmetics, textiles, detergents, paper, leather, agricultural and industrial chemicals, to improve a product or process. In some cases, an Igepon is selected because of its high or low foaming characteristics, its unique dispersing or emulsifying qualities, or for its excellent detergency; in others, an Igepon is selected for its wetting power, chemical stability or physical properties.

So whether you're looking for a surfactant in an agricultural wettable powder, a base for laundering detergents, or a bubble bath formulation, check with us on the correct Igepon to use in your particular application.

Write us today for information and samples of these unique, versatile surfactants.



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ANTARA® CHEMICALS

A SALES DIVISION OF GENERAL ANILINE & FILM CORPORATION

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SALES OFFICES: New York • Boston • Providence • Philadelphia • Charlotte • Chattanooga • Chicago
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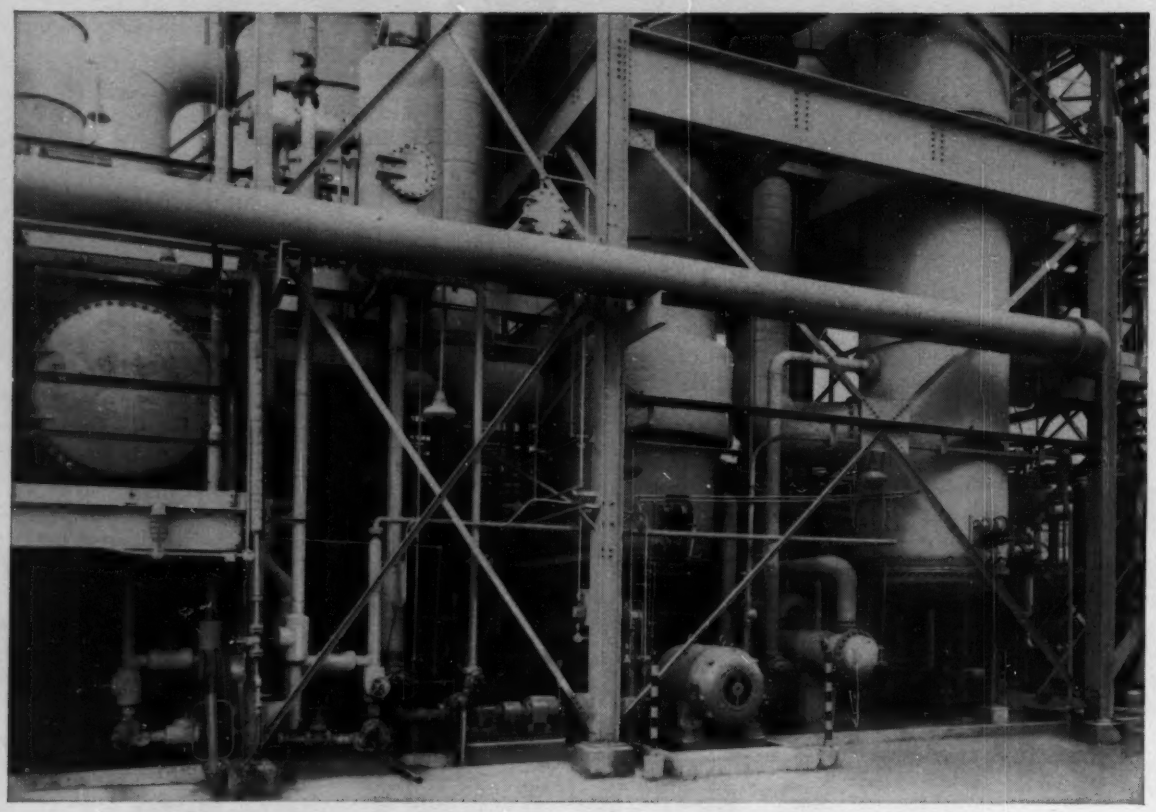


Shell Chemical gets fast, dependable and low-cost glycerine concentration with Buflovak Evaporator

In the production of glycerine at the Deer Park, Texas, synthetic glycerine plant, the Shell Chemical Corporation uses a Buflovak Triple-Effect, Combination Forced Circulation and Vertical Rapid Concentration type Evaporator.

High rate of heat transfer provides rapid evaporation and high concentration at moderate operating temperatures and lower power requirements. Long operating periods mean capacity production of uniform quality glycerine.

Let us help you with your liquid concentrating problems. A Blaw-Knox Process Equipment Engineer will be glad to work with you—study your problem, make recommendations and an estimate.

We invite you to write for complete information.

A Complete Process Equipment Service

Evaporators of every description constitute but one phase of Blaw-Knox Process Equipment design, engineering and fabrication service for the chemical, food, pharmaceutical, plastic and resin, petroleum, rubber and other industries:

EVAPORATION • DRYING • FLAKING
MIXING • IMPREGNATING • REACTION
VULCANIZING • SOLVENT RECOVERY
SOLVENT EXTRACTION • STERILIZING
DISTILLATION • CRYSTALLIZATION
POLYMERIZATION • GAS CLEANING
VAPORIZATION • GAS ABSORPTION
HEAT TRANSFER • CONDENSATION
LOW AND HIGH PRESSURE PROCESSING

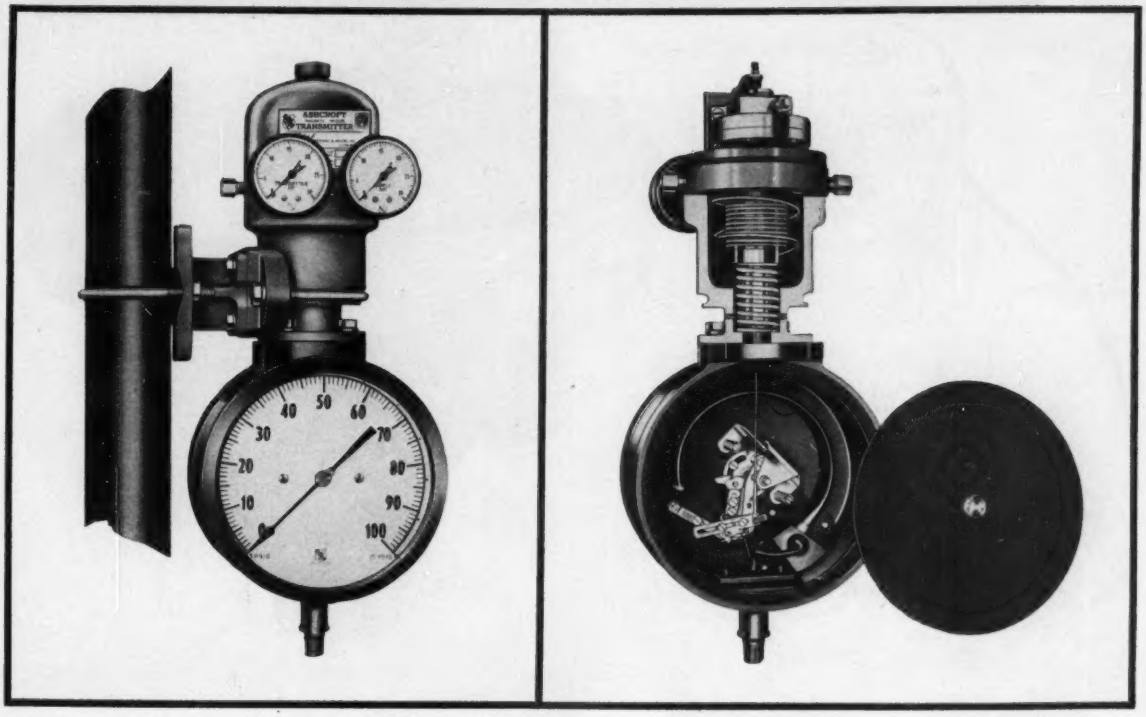
BLAW-KNOX

BLAW-KNOX COMPANY
BUFLOVAK EQUIPMENT DIVISION
1551 Fillmore Avenue, Buffalo 11, N.Y.

Makers of process equipment engineered to any temperature, pressure, capacity, reaction

Designed to solve safety and service problems

...THE NEW ASHCROFT PNEUMATIC PRESSURE TRANSMITTER



This new Ashcroft Pneumatic Pressure Transmitter is particularly recommended to processing industries and power stations. It combines speed and accuracy with maximum protection and serviceability.

The new design features the 6" indicating Ashcroft Maxisafe Duragauge, long known for dependable performance. It has an integrally-cast solid metal wall between dial and pressure sensitive element so that the transmitter can measure pressures up to 100,000 psi with complete safety for personnel and equipment. If misapplication ruptures the Bourdon tube, the Teflon-coated back cover serves as a safety blowout relief.

Another outstanding design advantage is easy access to both gauge and transmitter sections. Simply remove the safety-relief back cover and both the gauge and transmitter can be calibrated. Yet a sealed housing makes the entire assembly weatherproof.

The transmitter operates on low-pressure air. No need for expensive high-pressure lines and fittings. Supply air pressure as low as 18-20 psi for 3 to 15 psi output provides especially advantageous operation where electrical wiring might be a hazard. Inflammable, poisonous or corrosive liquids or gases are confined close to their source, away from the central control point.

The Series 1250 Ashcroft Pneumatic Pressure Transmitter is available with pressure sensing elements in all standard pressure ranges and Bourdon tube materials. Installation of the transmitter is easy. Small diameter tubing may be used, and the pipe, stem, wall or flush mounts are interchangeable in the field. Get complete operational data and construction details. Write for Bulletin 340.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has the broad knowledge and thorough experience essential to satisfy every requirement of your Ashcroft Pneumatic Pressure Transmitter application. You get fast, economical service from his local stocks.

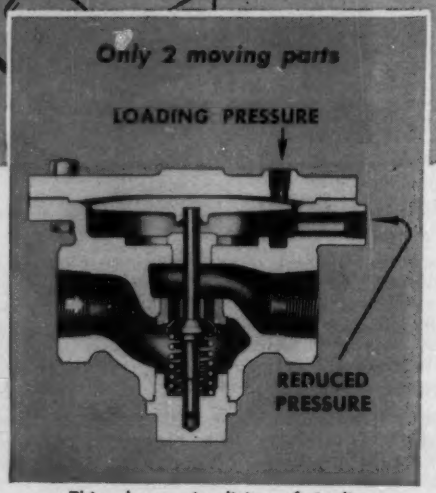
In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

Now Leslie brings you this New NO MAINTENANCE* Reducing Valve



This shows simplicity of Leslie Class G-1 pressure reducing valve.

HERE IS AN AMAZINGLY SIMPLE air loaded, diaphragm operated, pressure reducing valve that is virtually maintenance-free for steam heat or process steam application.

Only two moving parts and no seals, no stuffing boxes, no small dirt-catching parts — practically nothing can get out of order! And a stainless steel hardened main valve with highly polished finish minimizes wear.

This new Leslie valve instantly feels the effect of any flow change and responds to changes as small as 0.1 psi. It can be adjusted easily from minimum to maximum of reduced pressure range from a remote point, even a thousand or more feet away.

This valve is used in steam process and heating lines. And, its uses are unlimited for any steam reductions within body material limits (250 psi, 450°F).

Ask your Leslie engineer to tell you more about this amazing valve. He's listed in your classified directory under "Valves" or "Regulators".

***guaranteed no maintenance for 3 years.**

Send for Bulletin 561 today.

TRADE LESLIE MARK

REGULATORS AND CONTROLLERS

LESLIE CO., 279 GRANT AVENUE, LYNDHURST, NEW JERSEY

CONTROLLED QUALITY MEANS QUALITY CONTROLS

Let us put the SQUEEZE

ON HIGH EVAPORATING COSTS

. . . AND GIVE YOU ASSURED RESULTS, TOO!

Here's why Swenson evaporation costs less and produces a better product! From start to finish, Swenson offers much more than the *equipment.* An exclusive service is provided that includes preliminary product research and testing in the Swenson laboratory . . . expert engineering of evaporators that are *customed* for your particular products . . . surveillance of operating procedures and periodic checks after installation. Swenson engineers are thoroughly experienced and have helped solve evaporating problems for thousands of firms in the process industries for *65 years!* Counsel with them about multiple-effect economy . . . about long-tube evaporators . . . forced circulation . . . calandria, basket, horizontal-tube and cast-lead types.

Let them tell you about the filters, crystallizers and spray dryers that will best meet your requirements. Talk to them about *any* phase of evaporation, filtration, crystallization or spray drying and you get the practical answer to economy plus product quality. Start things off now by asking for a Swenson Catalog . . . it alone gives valuable information!

SWENSON EVAPORATOR CO.
15669 Lathrop Avenue, Harvey, Illinois

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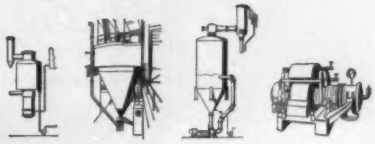
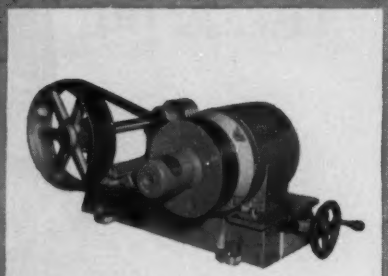
Proved Engineering for the Process Industries
Since 1889

A Division of WHITING Corporation



Evaporators Spray Dryers Crystallizers Filters



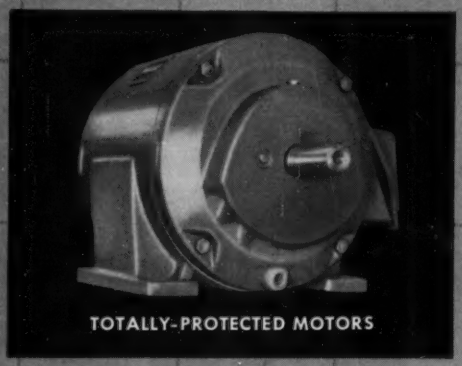
● WIDENING THE HORIZONS OF

Automation is the key to greater production of more goods and services at lower cost. The Tools of Automation can be applied profitably in a countless number of individual industries.

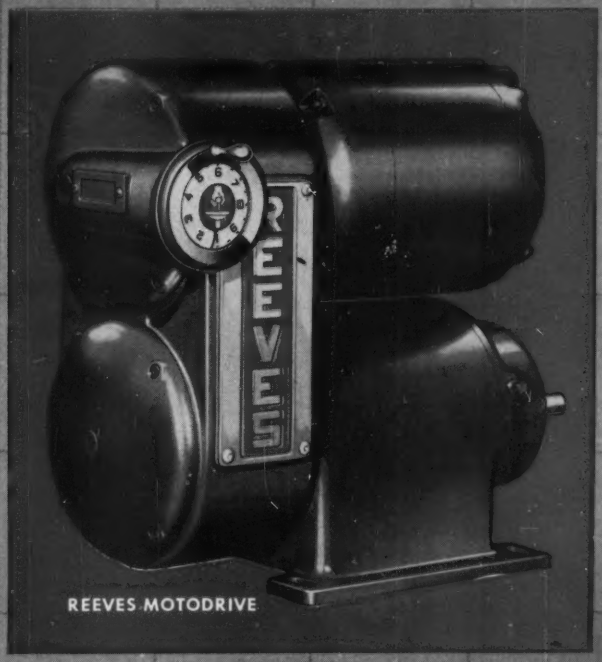
Reliance can provide *you* with valuable engineering assistance which can help secure the advantages of automation.

Our Tools of Automation consist of electric motors, variable-speed drives and controls.

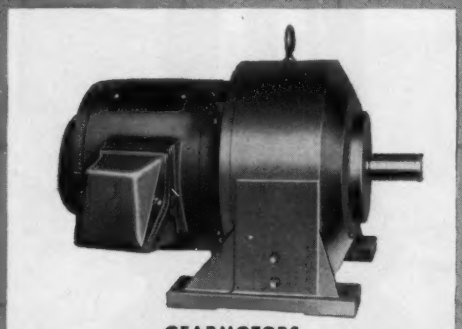
RELIANCE



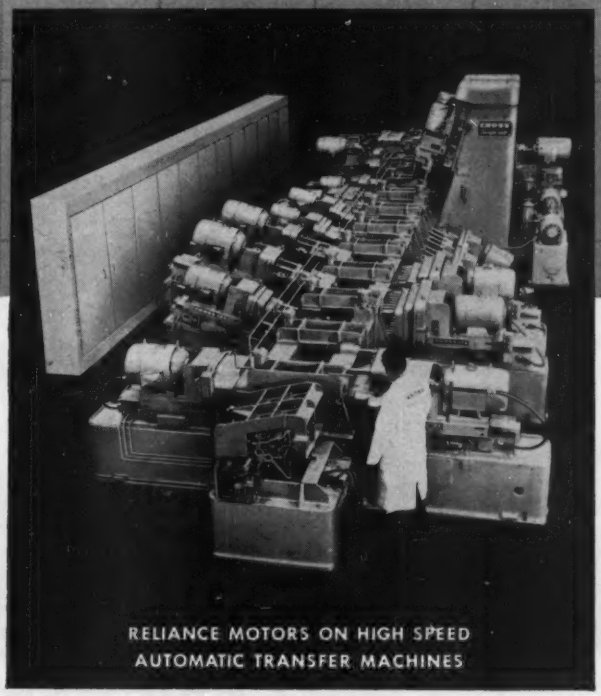
TOTALLY-PROTECTED MOTORS



REEVES MOTODRIVE



GEARMOTORS



RELIANCE MOTORS ON HIGH SPEED AUTOMATIC TRANSFER MACHINES

AUTOMATION

Application of these tools ranges from a single motor to multi-motor drives for highly complex production lines, where materials are processed into finished products in one continuous operation.

The world's largest manufacturer devoted exclusively to the production of quality motors and drives is ready to help you widen the horizons of automation in your plant.

Bulletin No. A-1555-B gives further details.

A-1519

ELECTRIC AND ENGINEERING CO.

DEPT. 135A CLEVELAND 10, OHIO

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West End . . . new producer of anhydrous sodium sulfate from natural source

The excellent acceptance by industry of this white, free-flowing material, guaranteed 99.5% Na_2SO_4, suggests your consideration of West End as a new source of supply. We will be pleased to submit samples, prices and freight schedules on request. Please include specifications.

WEST END **West End Chemical Company**

SODA ASH • BORAX • SODIUM SULFATE • SALT CAKE • HYDRATED LIME

EXECUTIVE OFFICES, 1956 WEBSTER, OAKLAND 12, CALIFORNIA • PLANT, WESTEND, CALIFORNIA

STRUTHERS WELLS

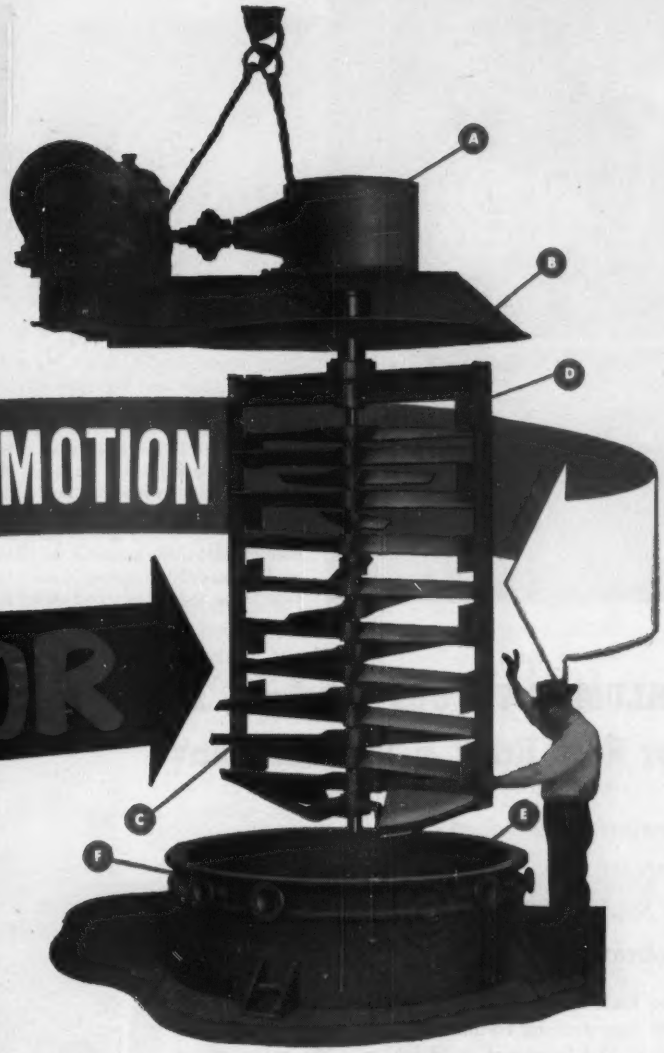
MIXING VESSEL

FOR PROCESSING

HEAVY VISCOUS

MATERIALS

Struthers Wells DOUBLE MOTION AGITATOR



A Double motion drivehead, an exclusive Struthers Wells design. Horsepowers from 2 to 150. Furnished with sealing devices when used on pressure kettles.

B Kettles can be open flat top, or dished and flanged closed top for working pressures as high as 300 lbs.

C Sweep and paddle arms are pitched to create flow of material throughout kettle—preventing stratifying of the mix. Scraper frame and paddle arms can be of welded design or bolted for easy removal when vessel is equipped with a cover.

D Scraper blades are advanced hinged type, which insures positive scraping action on 98% of the inside surface of mixer.

E Mixer can be fabricated of steel or special alloy to meet specifications.

F Kettles furnished with jacket or unjacketed for possible direct fire application.

For speed, economy and dependability—specify the Struthers Wells Double Motion Mixing Vessels—for processing greases and other heavy viscous materials. Our extensive machine shops and fabricating facilities—combined with years of engineering experience in designing all types of agitating vessels, enable us to furnish mixing equipment for any material, to your most rigid specifications.

For intricately designed or standard mixing equipment—*think first of Struthers Wells.*

STRUTHERS WELLS PRODUCTS

PROCESSING EQUIPMENT DIVISION

Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

BOILER DIVISION

BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

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Crankshafts . . . Pressure Vessels . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

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MACHINERY for Sheet and Structural Metal Forming . . . Tangent Benders . . . Folding Machines . . . Roller Table and Tumble Die Bending Machines . . . Press Brakes . . . Punching and Notching Machines . . . Forming Dies

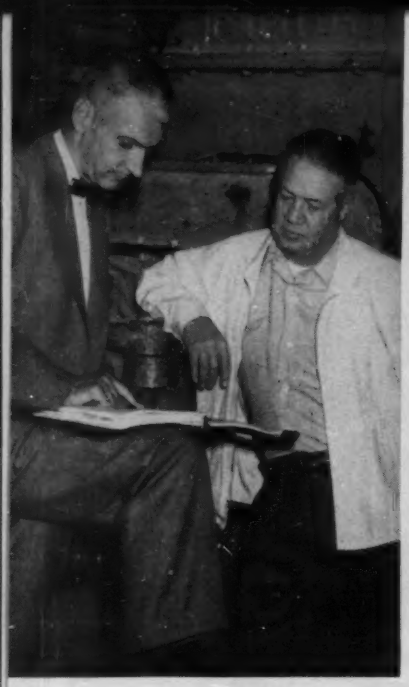
STRUTHERS WELLS *Corporation*

Struthers Wells

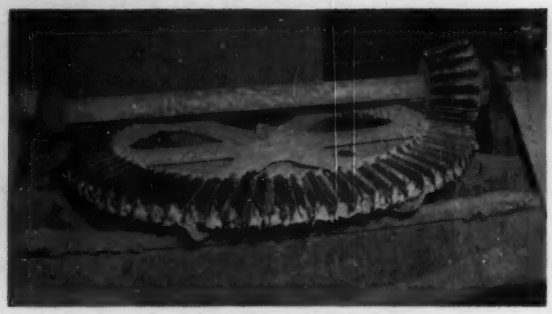
WARREN, PA.

PLANTS AT WARREN, PA. AND TITUSVILLE, PA.

Offices in Principal Cities



A. D. Schnurr (right), Kalo Brick & Tile Company president and Standard Oil lubrication specialist Roland C. Bleimehl discuss plant lubrication requirements. Providing technical service on lubrication is something for which "Rollie" Bleimehl is well qualified. Rollie is a mechanical engineer with a degree from Iowa State College and a graduate of the Standard Oil Sales Engineering School. He's been an industrial lubrication specialist for 10 years with the Standard Oil Company. Customers find his experience and training pay off for *them.*



Large open gear, such as this one in Kalo Brick & Tile plant, suffered excessive gear tooth wear until their Standard Oil man suggested switch to CALUMET Viscous. New lubricant eliminated throw off, reduced gear replacement and maintenance.

CALUMET Viscous Lubricant solves gear lubrication problem for Kalo Brick & Tile Company

Long-time Standard customer receives another demonstration of effectiveness of Standard Oil Products and technical service.

The Kalo Brick & Tile Company, Fort Dodge, Iowa was experiencing trouble with the lubrication of open gears. The lubricant used lacked adhesive qualities and was being thrown off resulting in excessive gear tooth wear. In addition, the lubricant had to be heated before application.

As they had done in so many cases during sixty-five years as a Standard Oil customer, Kalo management called in a Standard industrial lubrication specialist. Inspection and recommendation by the Standard man resulted in a switch to CALUMET Viscous Lubricant for open gears. Kalo Brick & Tile Company got these results: gears received an effective shield that did not throw off, life of gears was lengthened and lubrication maintenance and attention greatly reduced, no preheating of CALUMET Viscous Lubricant was required so this messy job and the preheating equipment were eliminated.

No matter what the problem, chances are Standard Oil lubricants and technical service can help you solve it. Try them. Call your nearby Standard Oil lubrication specialist in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

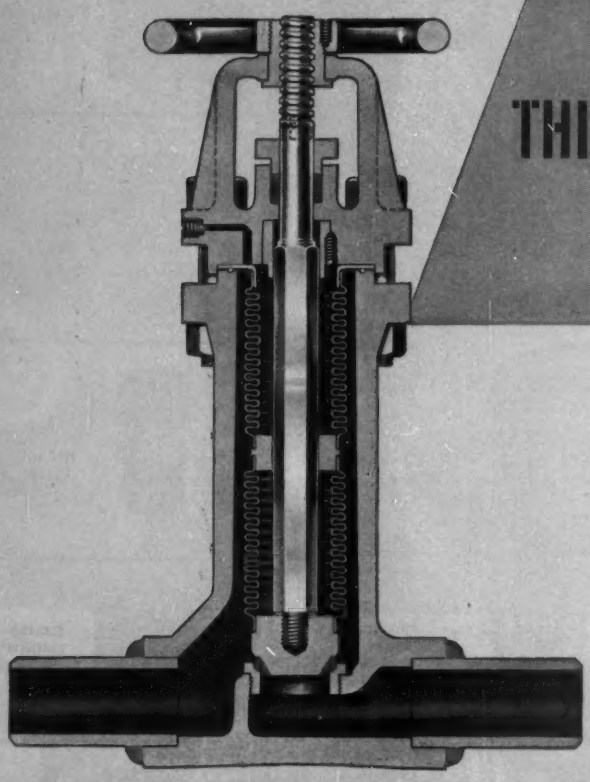
Kalo Brick & Tile Company plant, Fort Dodge, Iowa found solution to gear lubrication problem by using CALUMET Viscous Lubricant.

Quick facts about
CALUMET Viscous Lubricant

- **Not a residual product but a true grease carefully manufactured from selected soaps, oils and additives.**
- **Good wetting ability. Gives lubricant superior adhesiveness, makes it resistant to washing.**
- **Has very high load-carrying capacity. CALUMET Viscous grease formula is especially designed to provide effective shield under heavy load.**
- **Resistance to heat. Since it is a true grease compound, CALUMET Viscous has extreme stability, does not thin out under high heat.**

STANDARD

STANDARD OIL COMPANY
(Indiana)



WHAT MAKES THIS PACKLESS VALVE LEAK-PROOF?

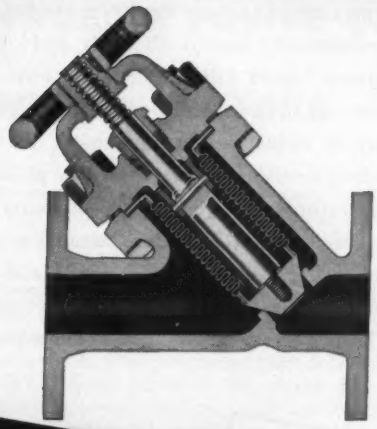
Even at pressures of 500 psi and temperatures of 1000°F., Sylphon Packless Valves prevent corrosive or flammable fluids from leaking and creating hazards.

How? Simply by using a bellows seal around the valve stem . . . not an ordinary bellows, but a SPECIAL SYLPHON BELLOWS that gives added protection and safety. Here are some of its outstanding features:

- No weak seams to open and leak.
- Cold-worked and hydraulically formed for resiliency and long life.
- Extra thick sidewalls . . . 2 or more plies of metal for extra strength.

In Sylphon Packless Valves you get double protection . . . the bellows seal *plus* regular packing which functions only in an emergency.

There's a wide selection of sizes and types. Sylphon Packless Valves are available in brass, bronze, cast iron or stainless steel. Special types are available for specific applications in the chemical and atomic industries. For complete information, return the coupon below.



Mr. Controls

Robertshaw-Fulton

CONTROLS COMPANY

FULTON SYLPHON DIVISION

Robertshaw Fulton Controls Co.
FULTON SYLPHON DIVISION
Knoxville 1, Tennessee

Send Bulletin 813-JC describing all Sylphon Packless Valves.

Name_____

Company_____

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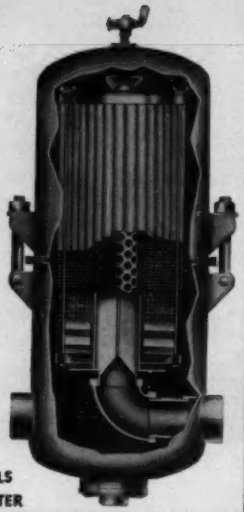
Do You Have Trouble Filtering These Liquids?

YOU NEED

STAYNEW LIQUID FILTERS

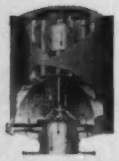


MODEL ELS
LIQUID FILTER

Name a liquid . . . any liquid! Somewhere in the world it is undoubtedly filtered efficiently and economically by a Staynew Liquid Filter. The world-wide use of Staynew Filters on thousands of liquids is proof of their adaptability to virtually any requirement. All known types of filtering media are available for any problem regardless of temperature, pressure, or corrosion factors. And, all Staynew Model ELS Liquid Filter bodies are available in steel, stainless steel, monel, herculoy and other non-corrosive materials. Construction can be according to ASME or API Code specifications. Let us know your requirements.

SOME OF THE LIQUIDS EFFICIENTLY FILTERED BY STAYNEW LIQUID FILTERS

- Acetone
- Acids
- Adhesives
- Alcohols
- Alkalis
- Ammonia
- Asphalt
- Benzene
- Benzine
- Beverages
- Butane
- Casein
- Castor Oil
- Caustic
- Cellulose Solutions
- Chlorine
- Chocolate
- Cleaning Fluids
- Coating
- Coolants
- Cutting Oils
- Emulsions
- Enamels
- Ethanolamine
- Ethylamine
- Extracts
- Flameproofing Solutions
- Fuel Oil
- Furniture Polish
- Gasoline
- Glue
- Greases
- Gums
- Hydraulic Fluids
- Ink
- Kerosene
- Lacquers
- Latex
- Liquid Paraffin
- Lubricants
- Molasses
- Naphtha
- Paint
- Pharmaceuticals
- Propylene
- Quenching Oils
- Resins
- Rubber Cements
- Sizing
- Soap
- Solvents
- Steam Condensate
- Syrups
- Tar
- Turpentine
- Varnish
- Vegetable Oils
- Viscose
- Water
- Wax

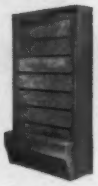


INTAKE FILTERS

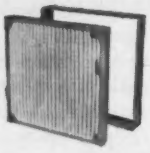
LIQUID FILTERS

PIPE LINE FILTERS

ELECTRO-STAYNEW PRECIPITATOR



AUTOMATIC AIR FILTERS



PANEL FILTERS

SPECIAL FILTERS

DOLLINGER
PROTECTOMOTOR
STAYNEW FILTERS

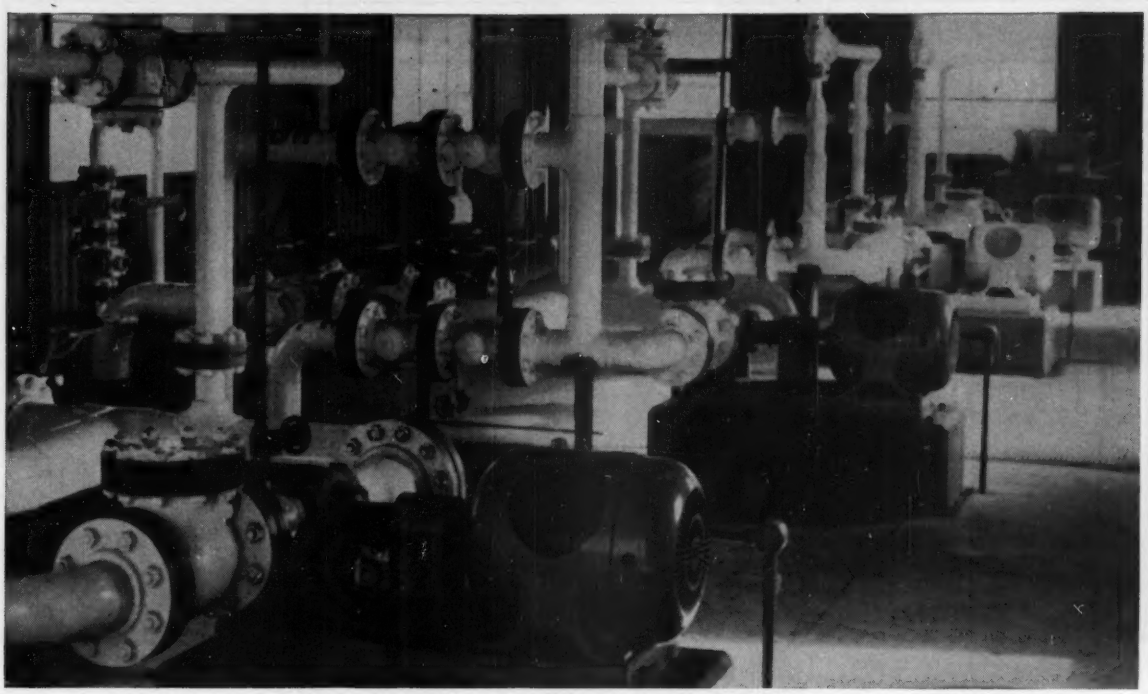
DOLLINGER CORPORATION

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

Send for 12-page Bulletin 300. Contains engineering and performance data, photos, descriptions of filtering media, recommended use of each, and other helpful data.

Dollinger Corporation, 4 Centre Park, Rochester 3, N. Y.

LIQUID FILTERS • PIPE LINE FILTERS • INTAKE FILTERS • HYDRAULIC FILTERS
ELECTROSTATIC FILTERS • DRY PANEL FILTERS • SPECIAL DESIGN FILTERS
VISCOUS PANEL FILTERS • LOW PRESSURE FILTERS • HIGH PRESSURE FILTERS
AUTOMATIC VENTILATION FILTERS • NATURAL GAS FILTERS • SILENCER FILTERS

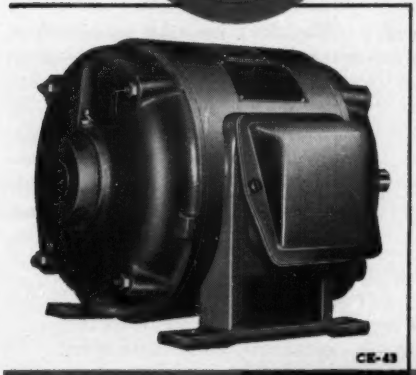


7½ H.P. Century motors drive loading pumps in a processing plant.

Protect your production...

WITH THE DEPENDABLE POWER OF

Century Performance-Rated© MOTORS



CE-43

Modern production machines are designed for new speed and efficiency. But to deliver their finest performance, they require precisely the right type and size of motor . . . Performance-Rated Century Motors!

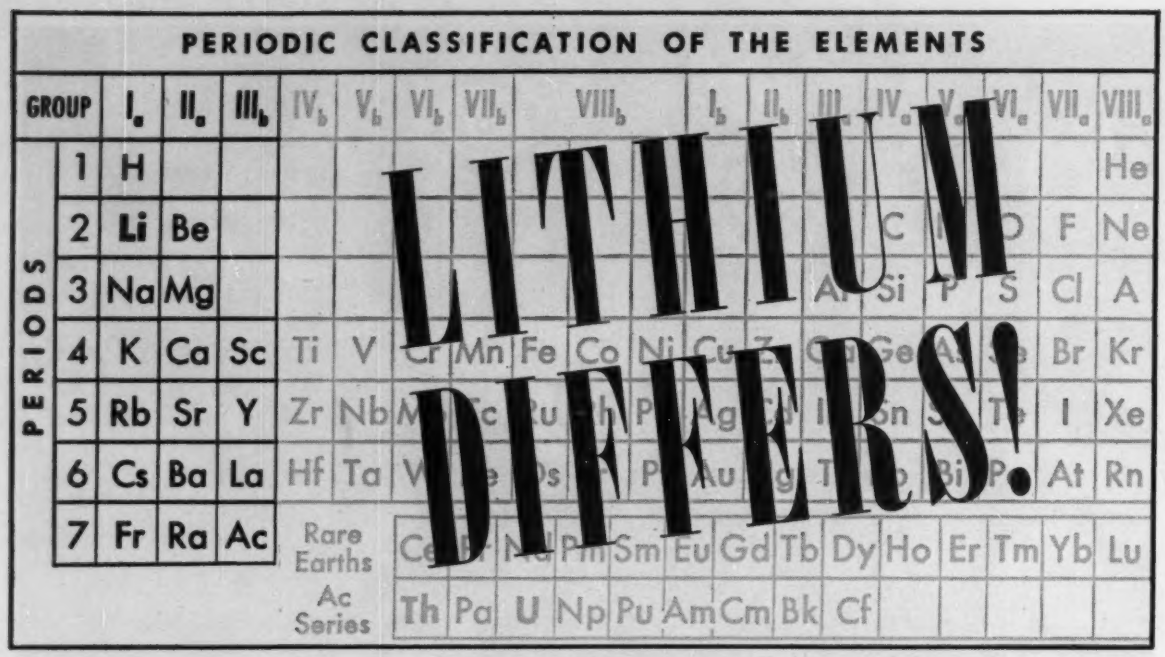
Performance-Rating is the simple process of selecting motors with the correct size, speed, frame, mounting and torque characteristics to fit your machine requirements. It's easy. From Century's unusually wide selection, you can choose motors from ⅛ to 400 H.P., A.C. or D.C., single phase or polyphase, drip proof, dust proof or explosion proof frames (plus optional corrosion-resistant features, constant speed, multi-speed, varying speed or geared speeds).

For full information, call the Century District Sales Office or Authorized Distributor nearest you.

Century Performance-Rated© Motors 1/8 to 400 H.P.

CENTURY ELECTRIC COMPANY

1806 Pine Street • St. Louis 3, Missouri • *Offices and Stock Points in Principal Cities*



Lithium, by reason of its atomic configuration and general characteristics, is rightfully included as the first member of Group I in the Periodic Table. A detailed study of the properties and reactions of both the elements and their compounds, however, shows that Lithium often resembles the metals of Groups II and III more closely than Group I. Following are some characteristic differences:

Lithium differs in organic chemistry . . .
because its organolithium compounds form a unique class with stability, solubility and activity characteristics intermediate between those of the Group I and Group II organometallic compounds.

Lithium also differs from the other alkali metals in that it serves as a unique catalyst for the polymerization of diolefins to materials of definite and predictable structure. It directs, for example, the polymerization of isoprene predominantly to 1,4 addition structures.

Again, recent investigations have indicated an interesting potential as a direct reducing agent in solvents such as ammonia, low molecular weight amines, and ethylenediamine.

Lithium differs in metallurgy...
inasmuch as the affinity of Lithium for oxygen, for example, is being utilized to reduce porosity in copper and copper alloy castings. Recent research has revealed that Lithium will produce brazing alloys with self-fluxing properties and increase the wetting ability of these alloys.

Lithium differs in inorganic chemistry . . .
the usefulness of Lithium Hydride and Lithium Aluminum Hydride in the preparation of other hydrides having already been widely demonstrated. Recent studies indicate that other complex hydrides prepared in a similar manner may prove to be interesting tools for research. The low dissociation pressure of Lithium Hydride at its melting point, to cite a specific example, is unique among all hydrides. LiH also has some slight solubility in polar organic compounds which is again unique among alkali metals.

Lithium differs in heat transfer . . .
based on its physical properties it has no equal as a liquid metal coolant. Due to corrosion caused at elevated temperatures by impurities in commercially available Lithium and Lithium Metal, Lithium has thus far found only experimental use.

Why don't *you* take a long look at Lithium? Its uniquely valuable differences in so many diverse fields may prove of great interest—and profit—to *you*. Write our PR&D department giving us details of the application you have in mind. Experimental quantities of Lithium Compounds are available on request.

. . . trends ahead in industrial applications for lithium

LITHIUM CORPORATION OF AMERICA, INC.
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MINES: Keystone, Custer, Hill City, South Dakota • Bessemer City, North Carolina • Cat Lake, Manitoba • Amos Area, Quebec • BRANCH SALES OFFICES: New York Pittsburgh • Chicago • CHEMICAL PLANTS: St. Louis Park, Minnesota • Bessemer City, North Carolina • RESEARCH LABORATORY: St. Louis Park, Minnesota

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Stainless Steel
GYRATORY SCREEN

Stainless Steel Construction makes cleaning easy... is corrosion resistant.

Large Screening Capacity. Self-contained unit provides as much as 35 square feet of screening area in 16 square feet of floor space. Gyratory action exposes product to all of screen cloth.

Wide Sizing Range permits handling of product sizes from 4 to 200 mesh.

Extra Cooling Surface of rib-type motor eliminates insulation burnouts under normal operating conditions.

Simplified Dismantling. Vertically locked deck arrangement eliminates need for enclosure. External tie rods facilitate fast removal of decks.

No hard-to-clean Nooks and Corners.

Dust-Tight — wide variety of installation-proved materials available for compression-type seals.

Two, Three, Four Separations . . . one outlet for each different size product. Collars and adjustable changes provide for quick attachment of flexible outlet tubes.

Full Freedom of Gyratory Motion made possible by universal-type stabilizers. No lubrication needed.

Low Power Requirements. A 1-hp motor drives unit of three or four decks.

Quiet, Vibrationless Operation assured by dynamically balanced mechanism.

Product Quality Protected. Gentle motion minimizes disintegration of foreign particles.

Secure, Vibrationless Foundation provided by sturdy, all-welded steel base.

You Get **MORE** When You Specify ALLIS-CHALMERS

Top efficiency in screening . . . maximum capacity . . . profit-insuring quality control . . . quick 'n' easy sanitation . . . simplified maintenance . . . economical operation — all these important advantages are yours when you specify Allis-Chalmers.

Your Allis-Chalmers representative will be glad to tell you more about this newest and finest of gyratory screens. Call him. Or write for descriptive Bulletin 07B8446. Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

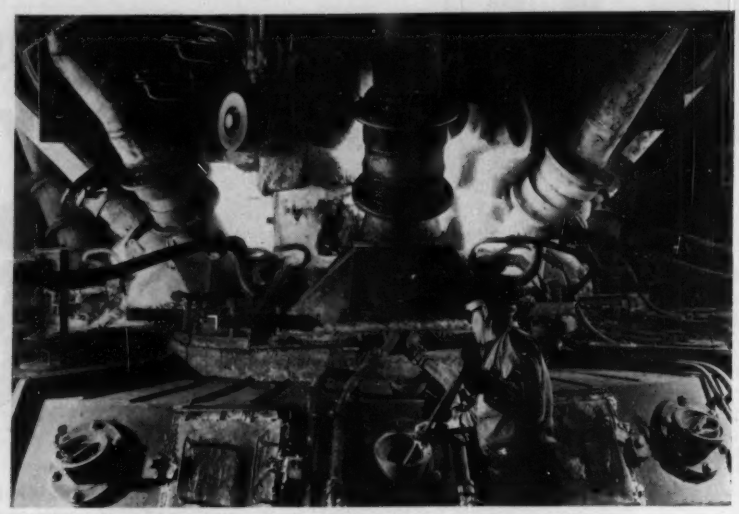
ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5074

Pictured Flowsheet

EDITED BY R. B. NORDEN



CALCIUM CARBIDE furnace: important link in process chain as . . .

Vinyl Acetate Thrives at Calvert City

At bustling Calvert City, Ky., the latest on stream is Air Reduction's new vinyl acetate plant. It's the successful adaption of a German process to U.S. practice.

No longer a "weak-sister," vinyl acetate is rapidly taking its place as a member of the aggressive plastic monomer-chemicals family.

Production of vinyl acetate in the U. S.—booming along—now stands at 110 million lb./yr.; double that of four years ago.

About 45% of monomer production goes into polyvinyl acetate, 27% into polyvinyl alcohol, 20% into butyral and about 8% into copolymers. All these are growing markets: PV acetate is in demand for "plastic" paints, PV alcohol for plastics, PV butyral for safety glass.

▶ **Newcomer Enters Field**—At busy Calvert City, Ky., a newcomer to vinyl acetate production — Air Reduction — has jumped into the market with a new 30 million lb./yr. vinyl acetate monomer plant costing over $3 million.*

Plant design is based on German processes (mainly Wacker-Chemie) adapted to U. S. practice. Lummus handled engineering and construction work. The process basically involves reacting acetylene and acetic acid vapors over a catalyst bed.

But Airco's operation is an integrated one: calcium carbide, acetylene and the monomer are all made at Calvert City.

▶ **Making Carbide** — National Carbide (a division of Air Reduction) produces calcium carbide by reacting high-purity limestone and coke.

The two raw materials are proportioned from stock bins and fed into four continuous closed-top revolving-hearth furnaces of Norwegian design. These are 30-ft. dia. by 20-ft. high, operate on 24,000 kw. They are built of steel lined with firebrick and carbon. Each has a capacity of 75,000 tons/yr. of calcium carbide.

The novel rotating hearth design counteracts crater formation, and keeps the charge porous so gas can escape easily. Also, the lining wears more uniformly, compared to stationary furnaces.

A feature of the carbide furnaces are Söderberg continuous self-baking electrodes. These consist of casings extending from the furnace to a platform above. A mix of fine coal, pitch and tar is added at the top. The lower end is baked by furnace heat and by the current passing through the electrodes. Temperatures in the furnace are in the order of 4,000 F.

Carbide is tapped continuously, it comes out as a fluid stream at 3,600 F. This is cooled, crushed and screened.

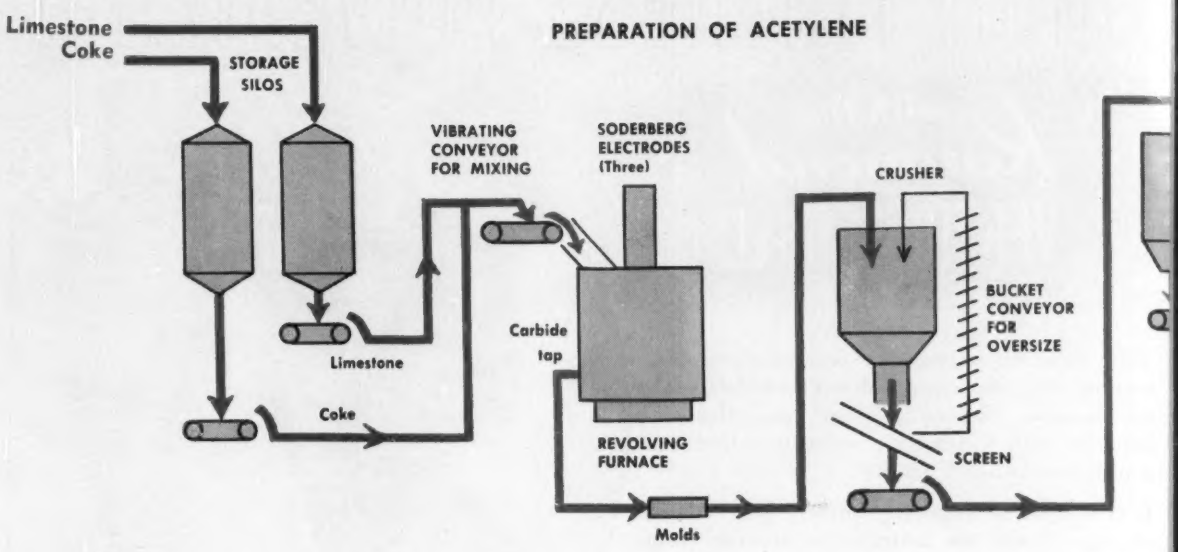
▶ **Making Acetylene** — National Carbide makes acetylene in continuous carbide-to-water generators operating at 15 psig.

Feed is handled through a system of hoppers arranged to permit nitrogen purging.

Acetylene — 99.5% pure — is delivered to gas holders, then picked up by low-pressure compressors for delivery to transmission pipe lines.

▶ **Making Vinyl Acetate** — Air Reduction uses a modification of the German Wacker process for making vinyl acetate.

*Other producers: Celanese, Carbide and Carbon and DuPont (for captive use only). In Canada: Canadian Shawinigan.



The catalytic vapor-phase reaction between acetic acid and acetylene was developed in Germany after World War I. But many improvements have been included since then.

At present the German Wacker process (plant at Burghausen, Germany) consists of reacting acetic acid vapor with acetylene. Acetic acid is withdrawn as a vapor from an evaporator. Acetylene is purified by passing through a chlorine-caustic soda purification system for sulfur and phosphorus removal.

Acetylene feed (plus recycle) mixes with the acetic acid vapors, and this mixture is progressively heated by passing through heat exchangers. Acetylene makes up about 15% of the volume of the mixture. This gas is finally heated to 340 F. by exchange with gas from the converters.

▶ **Converter System** — In these steel converters, arranged in parallel, reaction takes place in a catalyst bed—zinc acetate on a surface-active carrier (activated carbon). The catalyst is placed in steel tubes, 11.5-ft. high by 2-in. dia.

Reaction is highly exothermic:

$$CH{\equiv}CH + CH_3COOH \rightarrow CH_2{=}CHOOCCH_3$$

and the temperature is kept under control (340 F.) by circulating a heat transfer liquid through the catalyst bed. High yields depend on efficient removal of reaction heat.

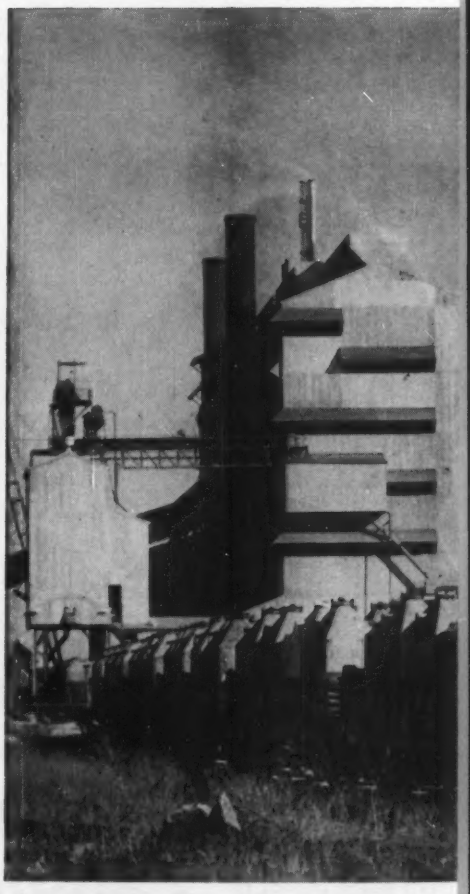
Gas, with reaction products, passes from the furnace through heat exchangers to a condensing unit where it's cooled to about 50 F.

▶ **Purifying the Monomer**—Unreacted acetylene gas comes off this unit and is recycled back to the system. Condensate goes to a stainless steel distillation column, where it's freed of acetaldehyde. A crude mixture of vinyl acetate and acetic acid then goes to stainless Raschig-ring columns where pure vinyl acetate is taken off overhead. Acetic acid sump is distilled in two other columns.

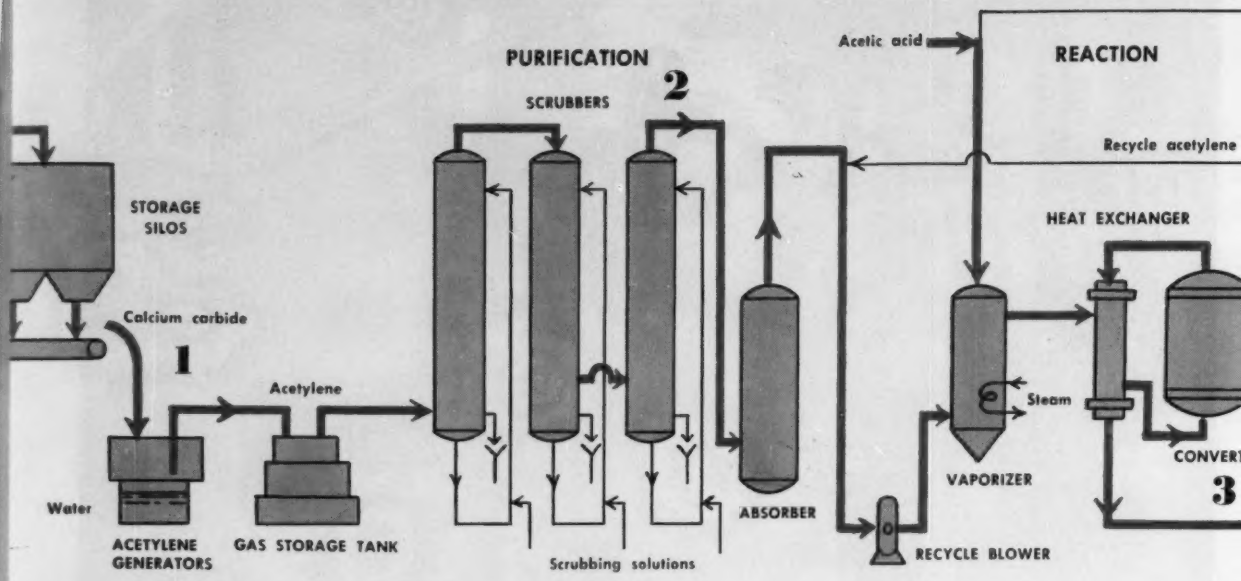
Yield of vinyl acetate monomer on acetylene is 92-95% of theory, or 97-99% of theory on acetic acid.

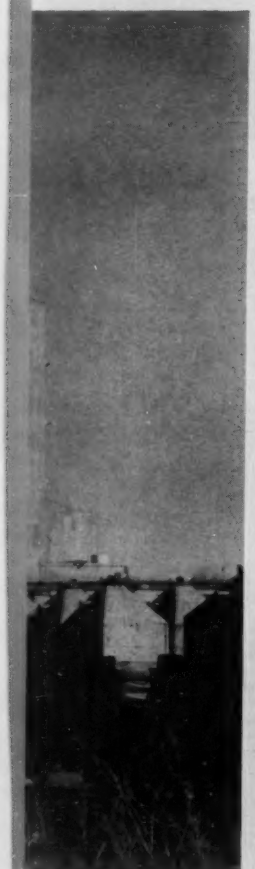
At Calvert City, Air Reduction uses a four-column purification system (see flowsheet)—two for purifying acetic acid. The acetic acid from the fourth column is recycled.

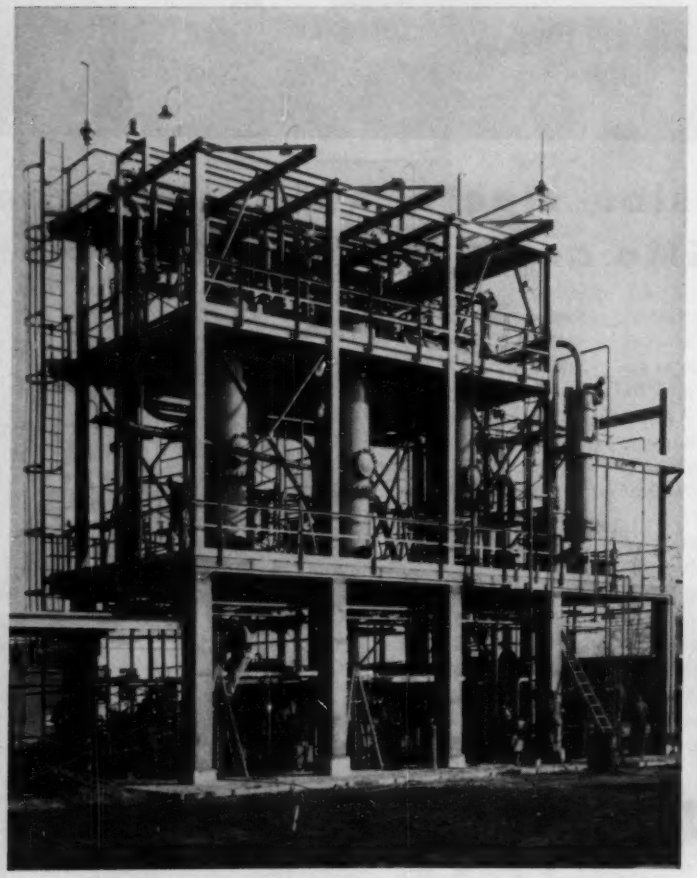
Air Reduction stores the monomer in aluminum tanks with nitrogen atmospheres. Two grades of vinyl acetate are produced—one contains a permanent inhibitor, diphenyl amine, which must be removed before polymerization. The other has a temporary inhibitor (60 days), hydroquinone.

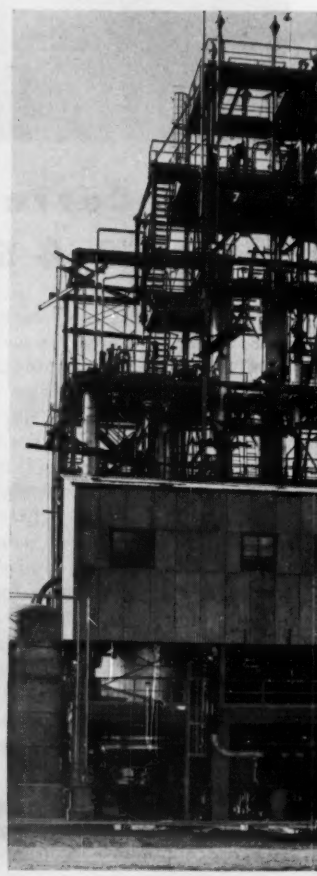


1 **ACETYLENE** is made by carbide-to-water City CaC_2 production is 3 billion cu. ft./yr.





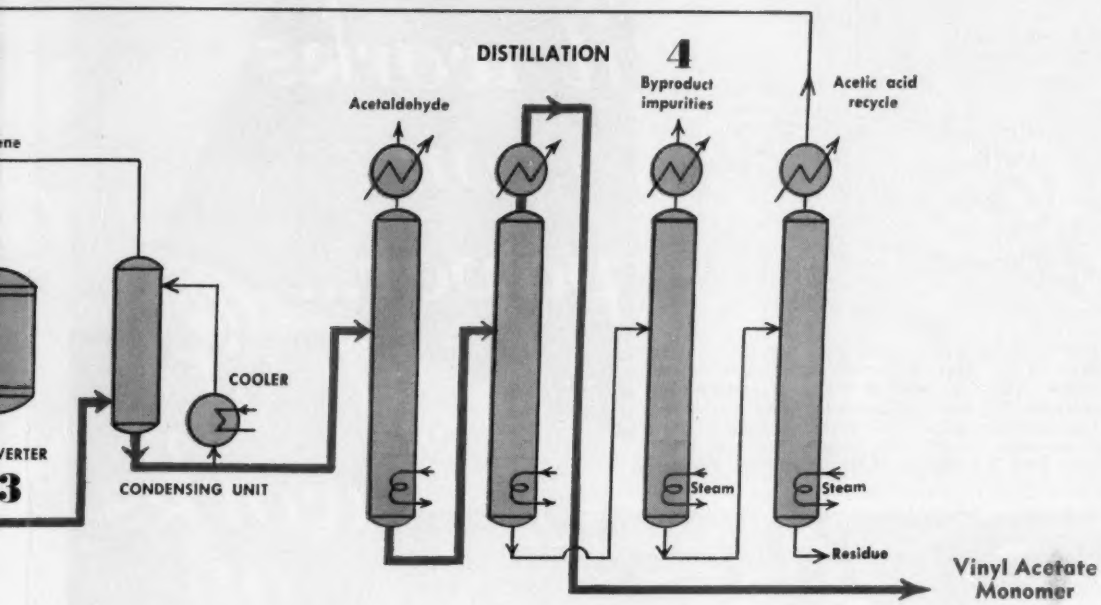


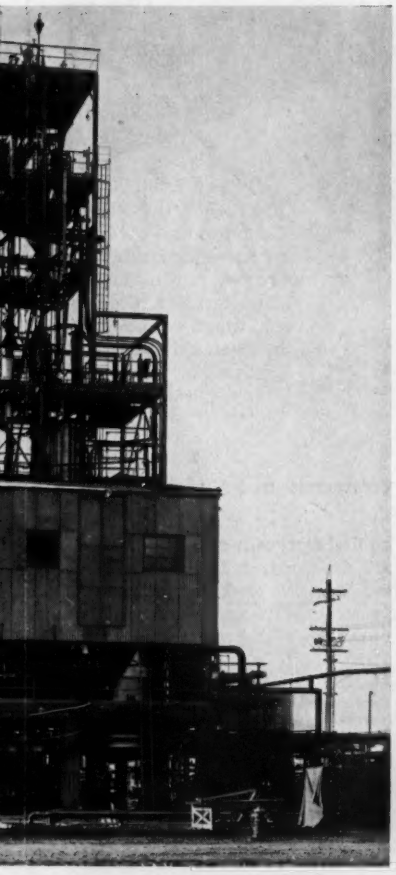


generators. At Calvert equivalent C_2H_2.

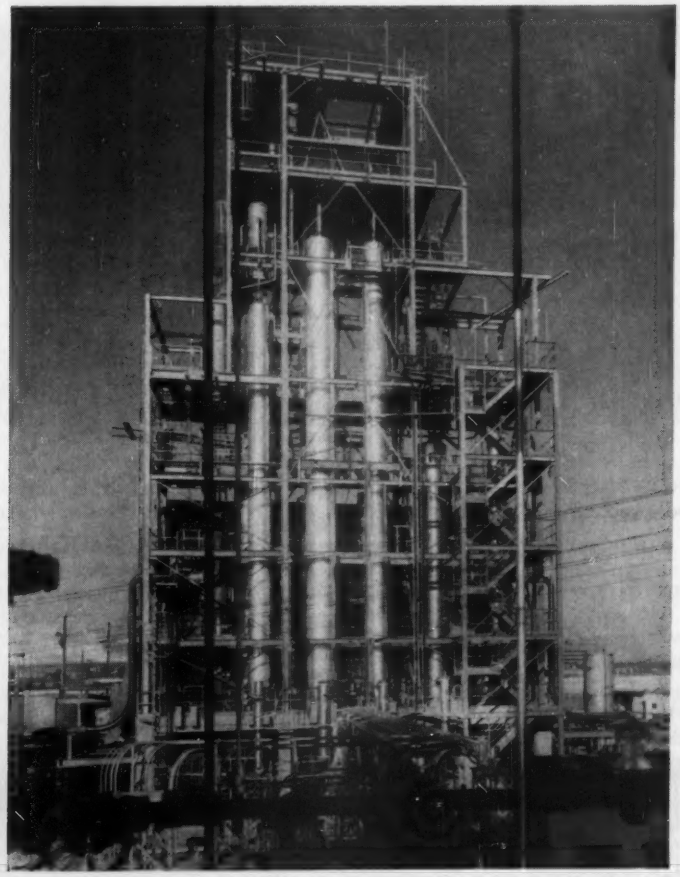
2 **ACETYLENE PURIFICATION** is handled in three packed towers for removal of sulfur and phosphorus impurities—catalyst poisons.

3 **CONVERTER** contains cata acetic acid vapors react to f

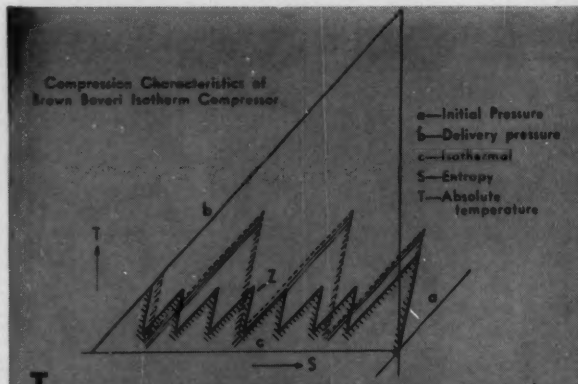




atalyst bed. Here preheated acetylene and to form impure vinyl acetate monomer.

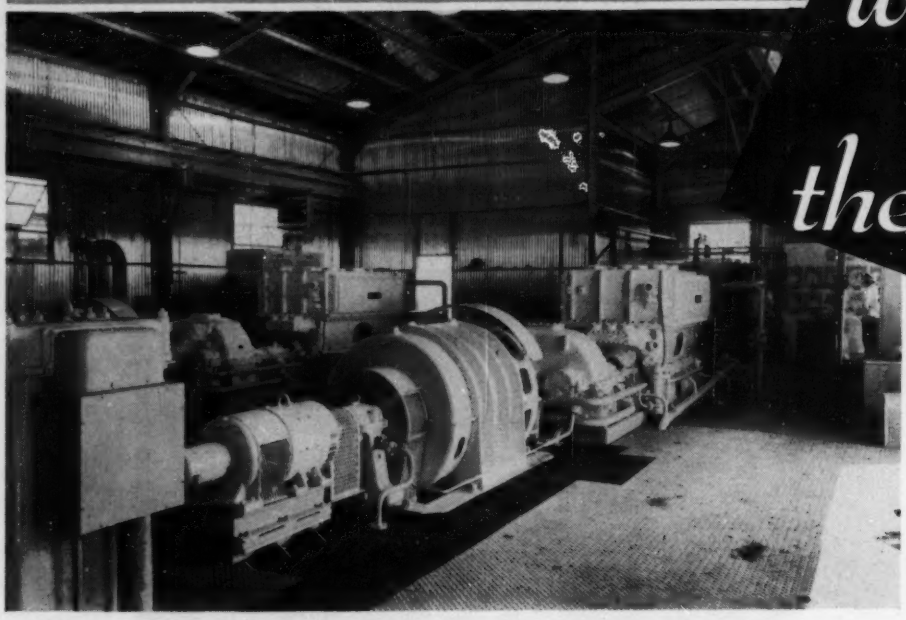


4 **DISTILLATION** system consists of four towers—two for purification of monomer, two for recovery of unreacted acetic acid.



THE Brown Boveri Isotherm Compressor compresses the air along the solid line (Z) in nine stages with seven intermediate coolers. This arrangement justifies the name of "Isotherm" because compression approaches the ideal isothermal line. The broken line indicates the compression characteristic when only three intermediate coolers are used. The difference between the areas below the compression lines is a measure of the difference in required power input.

it works on paper... it works on the job...



The two 7,000 SCFM Brown Boveri Isotherm Compressors selected by Brea Chemicals, Inc. for their new nitric acid plant at Brea, California, which was designed by Chemical and Industrial Corporation.

A BROWN BOVERI Isotherm Compressor unit makes possible major economies in any kind of chemical processing where large volumes of air at modest pressures is required.

Each unit is completely integrated equipment consisting of the inter-stage cooled isotherm compressor, a reaction-type highly efficient expander and a synchronous motor . . . all designed, manufactured and tested by Brown Boveri to operate as a "package" unit. Its design embodies more than a quarter century's experience in producing large air volume compressors for a wide variety of purposes *plus* a world-wide reputation for leadership in gas turbines and electrical power generating and distribution equipment.

Users of Brown Boveri Isotherm Compressors are assured of *greater efficiencies, substantial dollar savings in operational costs, longer life, dependable and trouble-free operation* and *far less maintenance* than with any comparable equipment on the market today!

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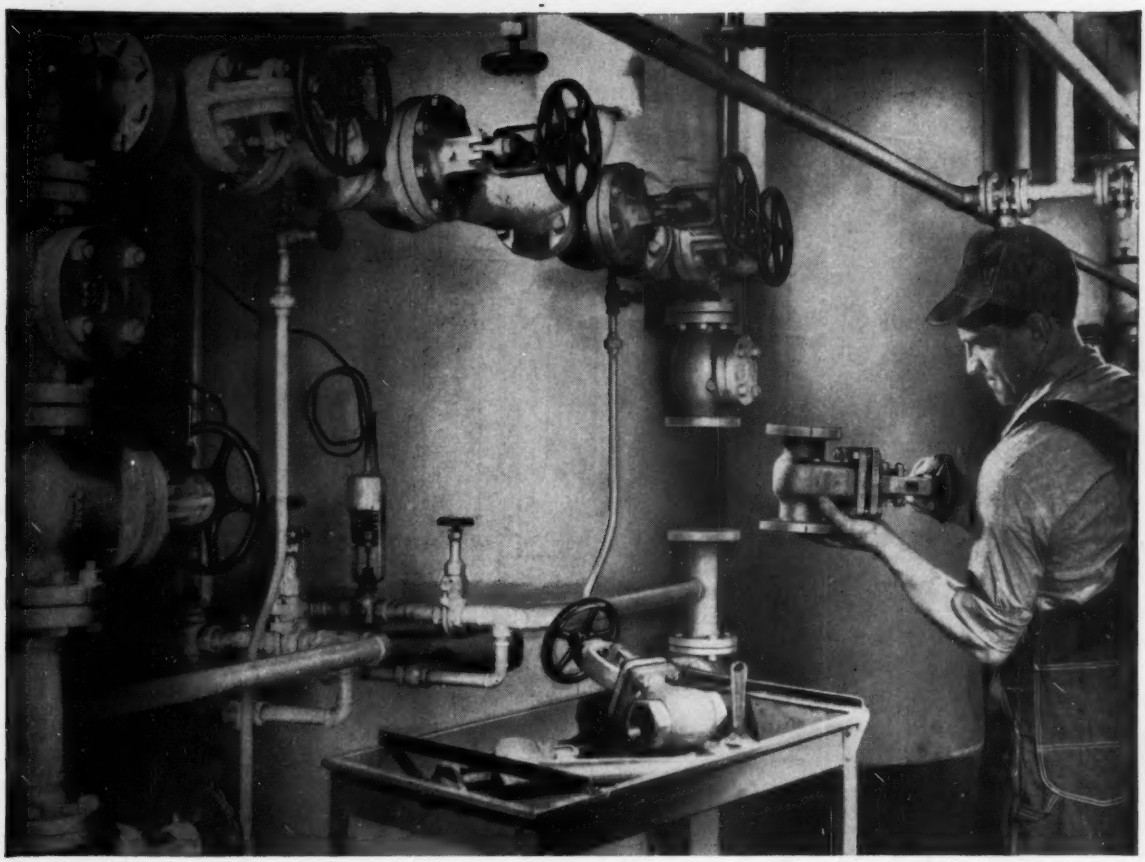


Corrosion meets match in Crane 18-8 SMo and Craneloy 20 valves

It's unanimous! These Crane valves for the process industries were *especially designed* of Crane alloys to cope with costly corrosion and to cut replacement costs.

The gate valves feature a simple, split-wedge disc construction which permits discs to rotate freely within guides and to seat tightly at all points on the seat perimeter. The free movement of the disc, plus uniform seating and unseating pressures, minimizes galling and seizing, reduces wear and allows smooth operation under all conditions.

Globe and angle valves now feature a modified plug-type disc that combines the advantages of the easier seating of the narrow ball-to-flat seat and the high resistance of the wider plug-type disc to corrosion, erosion and cutting. In addition, these valves offer a new swivel disc-stem connection that seats the disc squarely every time. Minimum clearance eliminates vibration.

These valves are available in 18-8 SMo and Craneloy 20 . . . in gate, globe, angle and check patterns . . . ½" to 6" . . . screwed or flanged ends. Rated 150 p.s.i. at 500° F.—230 p.s.i. at 100° F. *For more detailed information*, confer with your CRANE representative or write to the address below for the 12-page circular AD-2080.

Split-wedge disc gate.

Swivel disc globe.

Crane trunnion-mounted split-wedge disc combines the benefits of free rotation with uniform seat load pressure.

New swivel disc stem connection in globe and angle valves permits the disc to swivel freely on contact with seating surfaces.

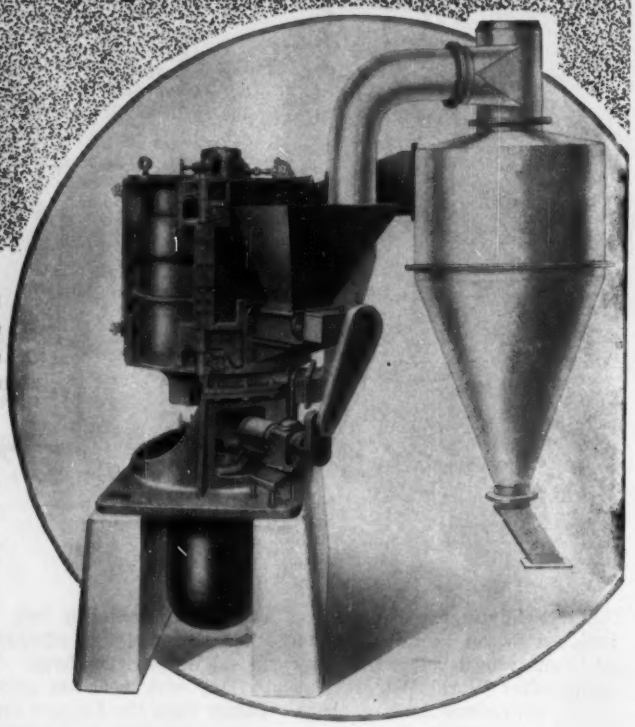
CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

HIGH-FINENESS PULVERIZING

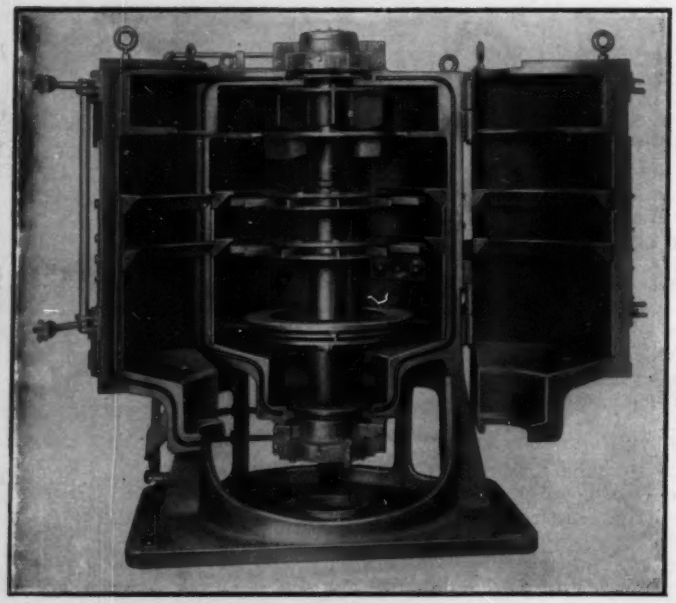
with the Raymond VERTICAL MILL



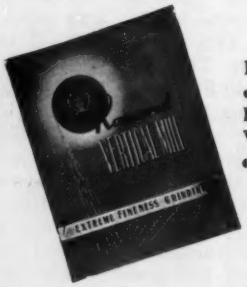
THIS practical pulverizing unit offers a direct method of producing powdered materials in the low micron sizes by a single pass thru the machine with whizzer air separation to insure a uniform finished product.

It saves time in handling different jobs. When changing from one material to another, clean-outs and new set-ups can be made quickly. The operation is clean, dustless and automatic. Whizzer separation offers easy, instant fineness control over a wide range.

The mill gives excellent results on chemicals, clays, talc, earth colors, cobalt oxide, vermiculite, and soft non-metallics. In scores of installations, the Raymond Vertical Mill has proved its unusual economy in making finest grades of materials.



- Hinged doors open wide for complete accessibility
- Double revolving whizzers maintain uniform fineness
- Simplified design . . . no gimmicks, close clearances or complicated adjustments



Details and applications in new Bulletin No. 78. Write for your copy.

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SALES OFFICES IN PRINCIPAL CITIES

EDITED BY M. A. GIBBONS

Monroe E. Spaght: Man of the Month

Shell Oil's executive vice president earns trustee status on Stanford University board

They don't pick a man for a school's board of trustees because he looks like the "professor type." He's wanted because of his standing in his field, his ideas on education and his proven interest in the school's welfare.

This time, though, with the election of Dr. Monroe E. Spaght to its board of trustees, Stanford University succeeded on all scores: Spaght not only measures up to requirements; he even looks as if he belongs on the faculty.

▶**Right At Home**—But aside from the resemblance, there's another reason why Monty Spaght feels at home on the California campus. He's no stranger at Stanford.

A native of Eureka, Calif., Dr. Spaght earned a bachelor's degree at the University at the age of 19 and returned during the next few years for two graduate degrees.

And his interest in the job that the schools are trying to do has continued from that time.

He has some mighty strong convictions about the high place of independent universities in the American scene and about alumni responsibilities.

And, somewhere along the line, he began to keep track of statistics on the number of secondary science teachers graduating from college as well as on the number of students electing physics and chemistry in the high schools. Figures showed that scientific manpower resources were scant in comparison with needs. What's more, he noted that of top calibre students (who comprise 25% of the nation's student body) only about half go on to higher education.

Spaght cites neglect of teacher paychecks as the main problem and singles out the public as the real culprit. It's his hope that Shell can help get the ball rolling in the right direction. Disgruntled teachers who feel badly neglected by the public can't do much to inspire students—in any field. Shell plans to sponsor greater recognition of teachers and here's one of the ways they plan to do it: This summer, the Shell Companies Foundation will sponsor seminars for 60 high school teachers at Stanford and at Cornell.

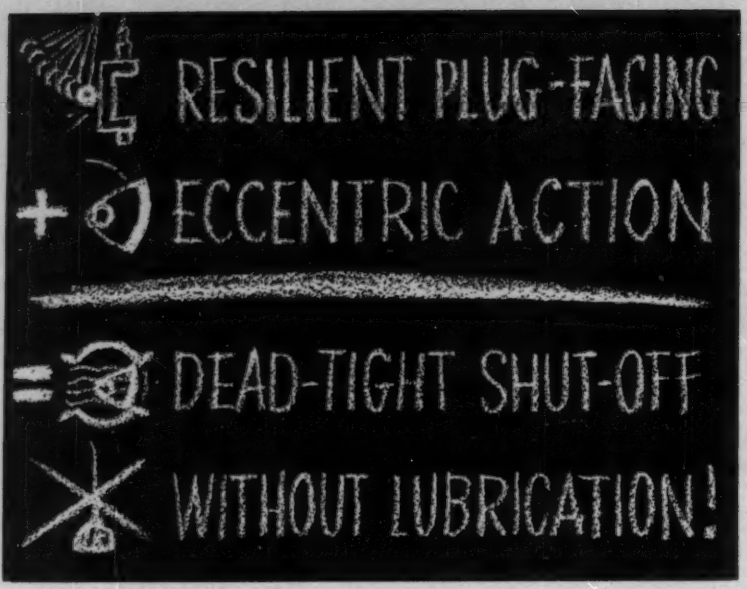
But, Spaght says there are other things to be done—two important items, especially. He hopes that industry will lead the way to more and more scholarship programs. There are still too many good students who simply can't afford to go on to college. It's his belief, too, that the independent universities need and deserve more financial support from industry.

▶**Official Assignments**—While still in his early twenties, Spaght spent a year abroad studying at the University of Leipzig. He went over on an International Exchange Fellowship sponsored by the Institute of International Studies and there studied physics.

That's one of the reasons why he was sent to Europe, in January, 1945, as a member of the U. S. Naval Technical Mission. The latter had been set up to study the German oil and chemical industries.

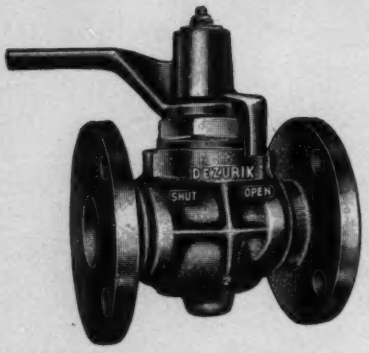
There were other wartime assignments too. Spaght was in charge of Shell's technical manufacturing operations on the West Coast, during the entire period of U. S. participation in the war. And, during that time, Shell built there nearly $30 million worth of new plants. (Many of these were important in the manufacture of aviation gasoline and synthetic rubber.)

Spaght was also active, during the war, on the government's Aviation Gasoline Advisory Committee, which determined the composition of aviation gasoline, and on the Ordnance Technical



DeZURIK EASY-OPERATING PLUG VALVES

with *exclusive* eccentric action, provide chemical processing plants with a plug valve that is equally efficient on lines carrying dry solids, corrosive liquids or gritty suspensions. They close tight—and open easily—*without lubrication!*



ON DRY SOLIDS

There is no danger of contamination from plug lubricants with DeZurik Valves. Yet, they open easily with a quarter-turn—without binding, without pinching, without friction! The plug touches the valve body *only* when the valve is closed.

ON CORROSIVE SERVICES

DeZurik Valves are manufactured in stainless steel and other high alloys for corrosive services. Plugs can be faced with a variety of resilient synthetic materials including TEFLON*.

ON GRITTY SUSPENSIONS

The resilient-faced plugs of DeZurik Valves close tight despite solids in the flow. In addition, the resistance of the plug to abrasive wear guarantees longer valve life. Valves can be supplied fully rubber-lined for specific applications.

Write Dept. E-5 for more details on versatile DeZurik Valves. Representatives in all principal cities.

DeZURIK SHOWER COMPANY
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NAMES . . .

Committee, which was concerned with the production of toluene.

After the war, the Shell executive was sent to Japan as a director of the U. S. Strategic Bombing Survey. Of particular value, at the time, was this group's report on the effects of strategic bombing of the oil and chemical industries.

▶ **Knows The Ropes**—But there was another, more important, reason to explain why the government called on him; experience in the field. He has spent his entire career in oil—all of it with Shell.

It was mid-1933 when he joined Shell as a research chemist in the Martinez, Calif., refinery. It wasn't long—15 months to be exact—before he became acting director of research there.

A year or so later, he was appointed technical assistant in the chemical department at Shell's Wilmington, Calif., refinery. There he helped in Shell's early work in polymerization and hydrogenation—key processes in aviation gasoline manufacturing.

When his various wartime stints with the government were completed, Spaght took on a Shell assignment, in New York, as vice president of Shell Development Co. That was back in March 1946. Less than three years later, he returned to San Francisco as president. Then, just three years ago, he became executive vice president of the parent company—back in New York again.

▶ **No Hobbies**—Spaght says he doesn't have any "hobbies" as such.

He spends a good bit of his time doing an enormous amount of reading. In order to get the most out of it, he organizes it; takes on a sizable chunk in only one field at a time. Current project is geology. He says he's "determined to have better than a casual knowledge of what geologists are talking about."

There are other interests too. He's mighty fond of music—particularly good jazz. Even admits to having tried his hand at the trombone some years back. Quietly, too, he tells you of his more than casual interest in antiques and good wines. But, he defies anyone to say very

much about his golf game. (He prefers to enjoy the latter and to wave aside any critiques!)

Because he's out of town so often on business trips, Spaght says that, actually, his "real hobby is trying to stay acquainted with his family:" his wife, the former Elizabeth Hull, and three children: Pearson, David and Sarah. They have a Scarborough, New York, home.

C. D. Thornton has been appointed to head the atomic energy operations of Farnsworth Electronics Co., Fort Wayne, Ind. Thornton is the former director of the AEC's general manager's office of operations analysis and planning.

Peter F. Casella has been named manager of the patent section of the research and development department, at Hooker Electrochemical Co.

Allan F. Kingsley has been named senior research chemist in Spencer Kellogg's new research center in Cheektowaga, N. Y.

R. S. Jane was elected president of Shawinigan Chemical Ltd., and **Victor G. Bartram,** who has retired as president, was named chairman of the board.

Henry C. Ott and **Julius M. Simmons** have joined Ebasco Services, Inc., as nuclear engineers. Dr. Ott formerly taught chemistry and chemical engineering at Rensselaer and, more recently was associated with the AEC's division of reserch. Simmons is the former assistant director of the Metallurgy div. of the Argonne National Laboratory.

Douglas C. Benton and **Robert L. Hull** have joined the reresearch and development division at Humble Oil & Refining Co. New members of the technical service division are **Billy Ashby** and **Robert L. Norris.**

Carlyle W. Gilbert has been promoted to manager of the Blaw-Knox resins and plas-

Freight rates are up—

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With rail freight rates up (and truck and barge rates slated to jump, too) the tare weight of your shipments is now more important than ever.

Shipping in Bemis Bags instead of heavier containers is probably your answer. Call your Bemis Man . . . let him show you how others have reduced their shipping costs * . . . and how you may reduce yours.

And there are other advantages. Bags are the lowest priced containers. You save on storage space, especially for the empty containers. Filling, closing and handling frequently cost you less.

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* **A couple of examples:**

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Western lettuce shippers reduced tare weight 975 pounds per car by using multiwall paper bags instead of cartons.

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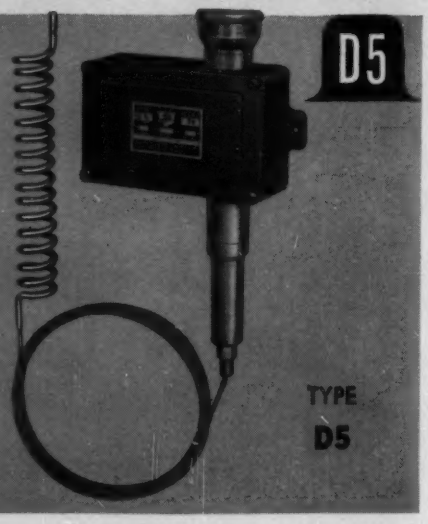

UNITED ELECTRIC's Type D5 Remote Bulb Temperature Control is a precision unit containing a micrometer adjustment for obtaining wide ranges and accurate temperature settings. This control has found extensive use in applications such as laboratory and industrial ovens, water baths, hot plates, etc.

Temperature Ranges	−150°F. to 200°F., 70°F. to 370°F., 100°F. to 650°F.
Switch Ratings	15 amps. at 115 or 230 volts A.C. Also 20 amps. or D.C. switches on specification.
Switch Types	N.O., N.C., or Double Throw — no neutral position.
On-Off Differential	Approximately 1.0°F. or 2.0°F. dependent on model.
Adjustment	Three-turn, calibrated knob rotated against graduated barrel. Readings and divisions equally spaced over entire range. Adjustment knob includes calibration screw.
Electrical Connections	Made to internally located terminal block via clearance hole in the enclosure.
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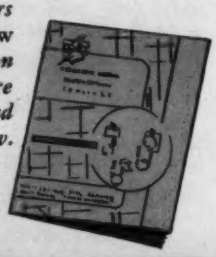
Enclosure	Die-cast aluminum case with black wrinkle finish. Other finishes available.
Mounting	Control head surface mounted in any position by means of dog ears. May also be flush mounted.

Complete information on the Type D5 appears in Section 200 of UNITED ELECTRIC's new *catalog. Section 200 contains detailed data on UE's complete line of remote bulb temperature controls. This information is clearly stated and attractively illustrated. Send for your copy now.*



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NAMES . . .

tics department, in the chemical plants division.

H. G. Schleicher, manufacturing superintendent in charge of technical service at Monsanto Chemical's Texas City, Texas, plant, has been promoted to manager of the firm's plant at Long Beach, Calif. **E. M. Jones** will replace him in Texas City.

Stephen M. Shelton, director of the U. S. Bureau of Mines' Region I and chief of the Bureau's Northwest Electro development lab at Albany, Ore., has resigned from government service to become general manager of a new plant—to be built by Oregon Metallurgical Co. The plant will turn out titanium and zirconium ingots.

David E. Deutsch has joined the technical staff of Fansteel Metallurgical Corp., as senior metallurgist. He'll concentrate on metallurgical problems relating to the national defense and atomic energy.

David C. Lea has been appointed research and development manager of the forest products div. of Olin Mathieson Chemical Corp., West Monroe, La.

W. B. Hart has been named director of the industrial wastes engineering division of Pantech, Inc., Folcroft, Pa. For the past thirty years, Hart has directed the activities of the waste control division of Atlantic Refining Co.

Myron Diggin is now vice president and director of Hanson-Van Winkle-Munning Co., Matawan, N. J.

Henry D. Noll has been appointed director of foreign operations for the Houdry Process Corp.

T. E. Moffitt and **R. W. Hooker** have been elected executive vice president and senior vice president, respectively, of Hooker Electrochemical Co., Niagara Falls, N. Y.

W. Alec Jordan

A new counseling service for the chemical process industries —The Chemical Data Co.—has been opened by W. Alec Jordan, at 270 Park Avenue, New York.

The new firm plans to make its analyses of markets and product development available to various firms in the chemical process field as well as to financial institutions. Jordan also intends to offer extensive training lectures for the guidance of sales promotion personnel.

Alec Jordan is the former editor-in-chief of Chemical Week magazine, at McGraw-Hill.

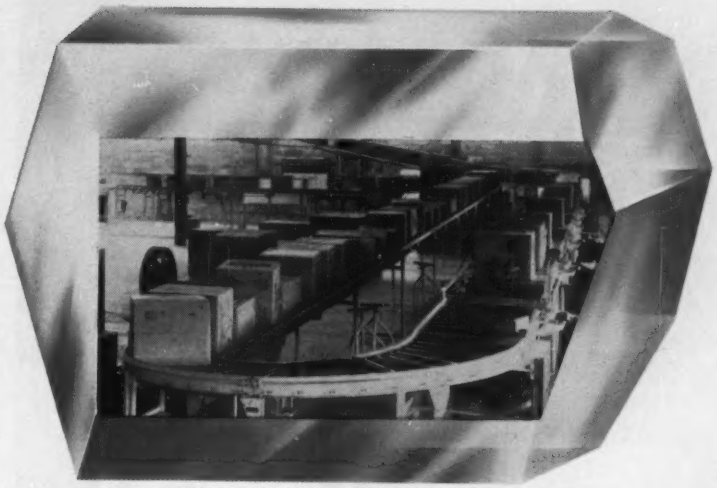
Benjamin M. Johnson is now doing research in applied chemistry with GE's heavy element chemistry unit of the engineering dept., at the Hanford Atomic Products Operation for the AEC.

Thomas J. Lamond has been promoted to the office of production manager in charge of vinyl for The General Tire & Rubber Co.

C. A. Hansen has been promoted to general foreman of cracking and polymerization at Humble Oil & Refining Co., Baytown, Tex., refinery. **C. H. Marshall** has been promoted to section head to direct activities of the solvents group.

Richard Chaddock has been appointed to the newly-created post of director of development for Hercules Powder Co.'s Virgina cellulose department.

George D. Kellen and **Willard P. Rhodes** have been appointed to chemical engineer-



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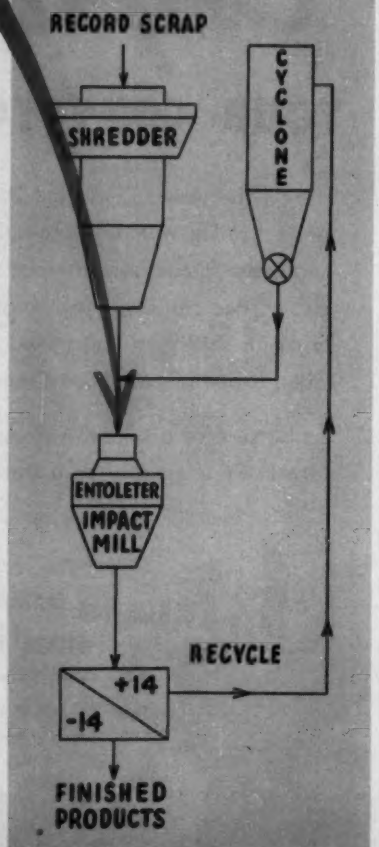

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ing posts with Chemstrand's quality control section and process assistance section, respectively.

Al F. Garcia has been appointed works manager of Kaiser Aluminum & Chemical's Mead reduction plant near Spokane, Wash. He succeeds **Lloyd A. Amos**, who will be works manager at the firm's new plant in Ravenswood, W. Va.

Seymore Goldwasser has been promoted to the newly created position of senior scientist in the research and development div. of Lever Bros.

Thomas L. Gresham has resigned his position as director of organic chemicals and engineering research at B. F. Goodrich to become vice president in charge of research activities for the A. E. Staley Mfg. Co.

The Tall Oil Div. of the Pulp Chemicals Assn. has presented cash awards to **Robert S. Aries** and **Melvin Wolkstein** of Polytechnic Institute of Brooklyn, **Jacobus Rinse** of Chemical Research Associates, and **Paavo Kajanne** of the Institute of Technology at Helsinki, Finland.

Fred H. Reed, general manager of the U. S. Chemical Milling Corp., has been appointed assistant to the president, **Charles H. Lundquist.**

Norton V. Coyle is the new president of Zirconium Corp. of America. The new vice president and treasurer—**Edward C. Sargent**—will also act as general manager.

F. X. Guimond is the new manager of pulp manufacturing at the Brown Co., Berlin, N. H. Guimond is the former supervisor of production of various dissolving pulps for the Canadian International Paper Co., Quebec.

E. L. Rhoads is the new manager of the derivatives department of Armour & Co.'s chemical division.

Shen Wu Wan

Dr. Shen Wu Wan has been named Director of research and development of Chemical Construction Corp., a unit of American Cyanamid Co.

Wan, now a naturalized citizen, was born in China where he did some of his undergraduate work at Yale-in-China. He received his doctorate in chemical engineering from Yale University in New Haven, Conn.

In 1935, he returned to China, where he became chairman of the Central China University chemistry department. Later, he became director of research and general manager of China Vegetable Oil & Chemicals Corp., Inc.

About 10 years ago, he joined the Yale faculty as a research associate. He has been a senior engineer with Chemical Construction since 1951.

Kem Meinert has been appointed head of the new industrial maintenance and anti-corrosion research laboratory at the Cook Paint & Varnish Co.'s main office in Kansas City, Mo.

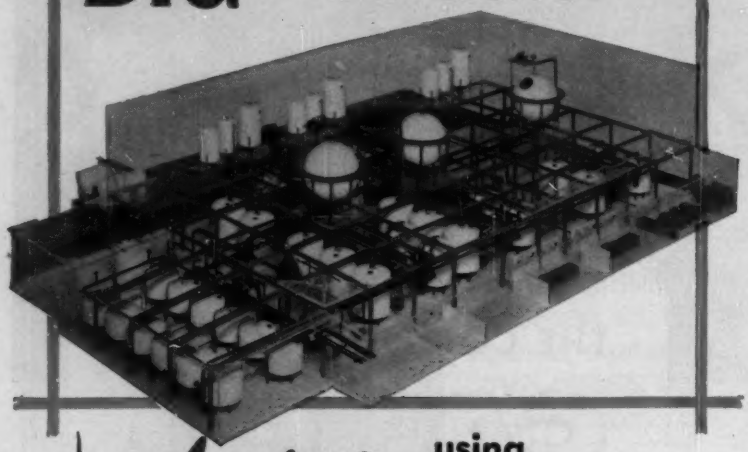
Morris J. Root, technical director of G. Barr & Co., Chicago aerosol manufacturer, has been named co-chairman of the membership committee of the Society of Cosmetic Chemists.

W. G. Orr has been promoted from technical superintendent to technical assistant at Texas-U. S. Chemical Co., Port Neches, Texas.

E. J. Stanton, was promoted to the position of senior chemical engineer at American Oil Co., Texas City, Tex. He will

Model of

BIG DEMINERALIZER EFFICIENCY



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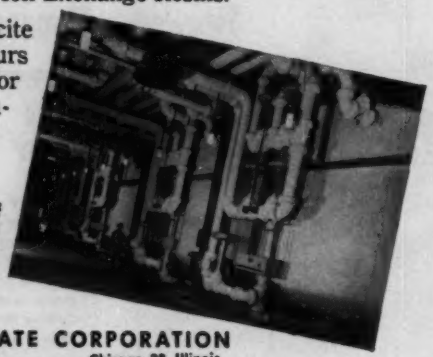

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NAMES . . .

also continue to serve as a group leader in the process design section of the research and development department.

Fred C. Hands, formerly manager of B. F. Goodrich Chemical's plant 3 in Akron, Ohio, has been named manager of the Institute, W. Va., synthetic rubber plant of Goodrich-Gulf Chemicals, Inc.

John P. Hamilton has been appointed manager of silicone production for Linde Air Products, in Tonawanda, N. Y.

Herbert M. Schroeder has been named a group leader in drying oils research at the Spencer Kellogg Research Center, Cheektowaga, N. Y.

Fred R. Sheldon has been named manager of the pulp and paper research and development at Becco Chemical Div., Food Machinery & Chemical.

D. Walbolt has been appointed manager of Shell Chemical Corp.'s newly established ammonia division district office at Fresno, Calif.

Charles E. Kwartler has been elected vice president of the Gamma Chemical Corp. He will be responsible for all operations at the Great Meadows, N. J., plant.

W. B. Brooks is the new senior metallurgist in Dow Chemical's Freeport, Tex., electrochemical engineering department; **E. H. Holt** has been promoted to laboratory supervisior in the central laboratory.

Leslie A. Chambers has been selected as the new research director of the Los Angeles County Air Pollution Control District, a position not filled since last June.

Emerson P. Poste, chemical engineer has merged his research and analytical facilities with those of the Industrial Research Institute of the University of Chattanooga, Tenn.

Robert U. Haslanger

Escambia Bay Chemical Corp. has elected Robert U. Haslanger vice president and general manager.

Haslanger is the former assistant to the president and director of sales, industrial chemicals, at Stauffer Chemical Co. Earlier in his career, he was associated with Monsanto Chemical where he held various posts in research, product development and sales. After graduation from the University of Wisconsin, he spent four years doing research and development work in the paper and cellulosics industry.

The Westport, Conn., executive is a member of the American Chemical Society as well as the Armed Forces Chemical Association.

Jack M. Noy has been named director of research for the Quebec Iron & Titanium Corp. Formerly, he had worked with Climax Molybdemun Co. as chief engineer.

Henry H. Reichhold has been named chairman of the newly formed executive committee of Reichhold Chemicals, Inc.; **Stephen H. Baum** is executive vice president and **Herbert W. Mason, Jr.**, is vice president and general manager.

Harry J. Karagas has been appointed to the position of manager of the process equipment division for the Rodney Hunt Machine Co., Orange, Mass.

Herbert Trotter, Jr., has been named vice president of engineering and research for the Sharples Corp., Philadelphia, Pa. For the past 10

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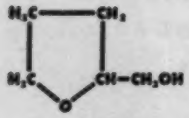

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NAMES . . .

years, Trotter has been associated with Eastman-Kodak Co.

Oliver C. Johnson, manager of the Socony Mobil Oil Co., Inc., refinery at East St. Louis, Ill., has been appointed assistant general manager of the firm's manufacturing department.

Sydney Steel, formerly director of Atlas Powder's planning staff, has been promoted to the position of industrial assistant to **Edward Goett,** vice president in charge of the firm's chemical division.

Erick Hoegberg has joined American Viscose Corp. as head of the technical information group. His headquarters will be at the firm's research center at Marcus Hook, Pa.

Hal Cooper has joined American Potash & Chemical in the newly created position of director of development engineering.

Otto N. Miller has been named chairman of the air pollution control committee of the Western Oil & Gas Assn., Los Angeles.

Donald Berry has been named manager of the low temperature & synthetic fuels department, chemical plants div., Blaw-Knox Co.

Alfred Bretschger has been appointed plant manager of the Vancouver plant of the Becco Chemical Div. of Food Machinery & Chemical Corp.; **Richard E. Elden** is the new production manager.

George E. Dyke, president and chairman of the board of Robert Gair Co., Inc., has ceived the 1956 honor award of the University of Maine Pulp & Paper Foundation.

Charles Boland Cooper has been named manager of B. F. Goodrich Chemical's plant 3 in Akron, Ohio. **Robert N. Rylands** has been promoted to production manager, at the same installation.

Harold L. Hansen

The new vice president of Sterling Drug, Inc., in charge of the Hilton-Davis Chemical Co. div., is Harold L. Hansen.

Chairman of Sterling's quality control committee since 1947, Hansen has been associated with the company for the last 14 years. Before coming to Sterling, he had been assistant professor of chemistry at Northwestern University Dental School.

Hansen, a native of Nebraska, did his graduate work in the chemical field at Northwestern University. Later, he taught chemistry there for nearly 10 years.

The Hilton-Davis firm manufactures flushed colors, dyes and other bulk materials.

Joseph H. Duff has been appointed assistant technical manager of the Graver Water Conditioning Co., New York.

Robert U. Haslanger has been elected vice president and general manager of Escambia Bay Chemical Corp.

H. H. Haaland has been appointed chief of the precipitator engineering division at Western Precipitation Corp.

The former Dewey & Almy Chemical Co., now merged with W. R. Grace & Co., has been divided into three divisions of the parent company. **G. Blackwood,** as president, will head up operations under the Dewey & Almy name; **Bradley Dewey** will handle the Cryovac Co. div.; and **Henry Gilbert** will take charge of overseas operations.

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✔ *always produces a superior mix*

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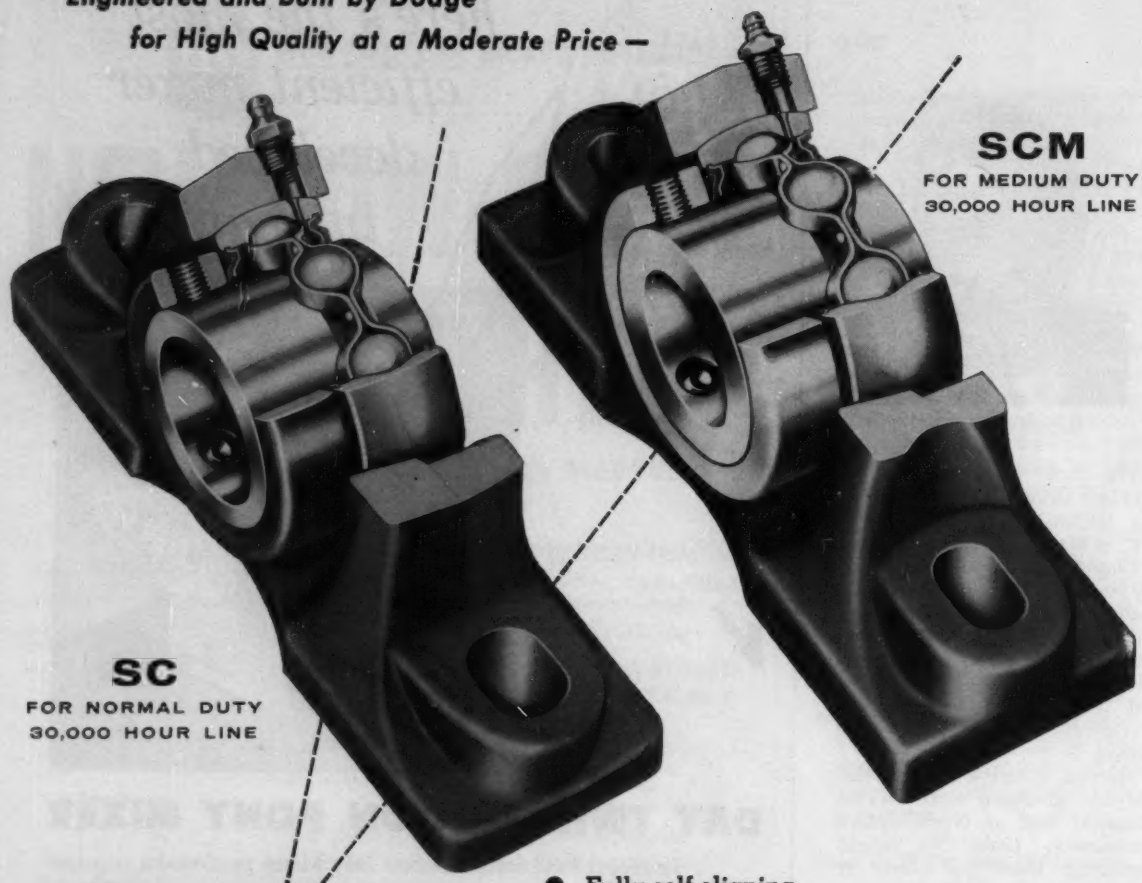

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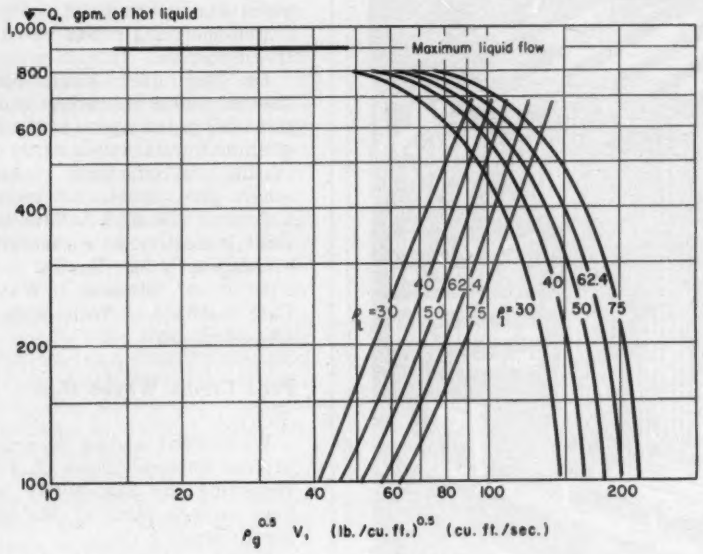

More on Tray Design

Sir:

I have just read the article, "Save Money on Bubble-Cap Columns," by Walsh and Lafyatis (Apr. 1956, pp. 193-6).

This article describes one limiting factor in tray capacity —buildup of liquid and froth in the downcomers to such an extent that the tray primes. The authors suggest that accompanying plots or similar plots be used for a quick check on whether a tray will have sufficient capacity.

It has been my experience that many trays, not specifically designed for a particular process, when used for another service will not be limited by the downcomer capacity but will flood because of bad vapor distribution. The measure of vapor distribution is frequently given in terms of h_s/h_c. If the authors would superimpose this factor on the graph, it would be much more useful.

Incidentally, there appears to be a typographical error which changes the meaning of one statement. On p. 194, Col. 2, the last word in the first paragraph should be "increased" rather than "decreased."

J. A. DAVIES

Texas Co.
New York, N. Y.

▶ *This apparent "typographical error" really represents a difference in viewpoint, as brought out in the author's reply below.*—ED.

Depends on Viewpoint

Sir:

The "typographical error" referred to by Mr. Davies occurs in our statement that, as vapor load decreases, static head also decreases. If this is thought through carefully, it will be seen that as the vapor rate goes down, the open area of the slots does decrease, the vapors come out higher on the cap and the static head is actually decreased.

Mr. Davies comments also on maldistribution of vapors. This is another criterion for tray design. Trays are usually considered in stable operation when h_s/h_c is less than 1.0. Lines for this condition can be superimposed on our plot, as Mr. Davies suggests, using the data already calculated to determine their

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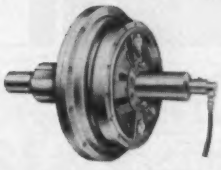

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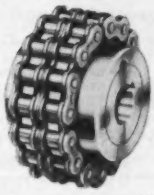

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location. This gives a family of lines having ρ_l as a parameter.

Location of these lines for the example used in the article is shown on the chart above. The area between the lines for a given liquid density is the preferred operating region based on this criterion.

On the other hand, many towers whose operating conditions fall in the region to the left of these lines are apparently operating satisfactorily, while others give trouble and require a further check. I believe that this indicates a conservative evaluation by Mr. Davies.

THOMAS J. WALSH
Case Institute of Technology
Cleveland, Ohio

Pro: Credit Where Due

Sir:

We enjoyed reading the article in your February issue (p. 122) regarding the high-purity tonnage oxygen plant at McLouth Steel Corp.

However, the name of Linde did not appear in this article. Since this firm played such an important role in the McLouth installation, we would like to point out that Gesellschaft fur Linde's Eismaschinen supplied the cold box and the major process equipment, along with the basic design.

C. F. HAUCK
Blaw-Knox Co.
Pittsburgh, Pa.

▶ *We're happy to give credit to whomever it is due.*—ED.

Application Is Limited

Sir:

A recent Plant Notebook Contest winner (Dec. 1955, p. 216) proposed the use of steam condensate to seal pump shafts. The suggested arrangement appears ingenious but, when carefully analyzed, it seems to have a very limited field of application.

Nothing is said about service conditions, either as to the steam or the duty of the pump. It has to be assumed that steam is available and at the right pressure; unfortunately, this is not always the case in process operations. Most pump manufacturers advise the use of water for the

purpose indicated. For low pressures it would be simpler to connect directly to a water service line. Too, if the pumping pressure is higher than the steam pressure, the suggested idea won't do.

Even sealing water, as shown in the arrangement, would require careful supervision, depending upon the conditions. It is usually recommended that there be some leakage of water through the packing. This is not always desirable, and it is a matter of opinion as to just how much is enough. If the pumping pressure is high and if the shaft has a rapid running speed, 10 cc./min. of water would hardly suffice.

Again, what if water is a contaminant or a diluent to the fluid being pumped? It would take very close adjustment of several variables to prevent water entering the pump.

Perhaps the idea is intended for small units under moderate conditions of service. I'm afraid there is much more to making satisfactory packing applications for severe service than just providing a source of water for the stuffing box.

WALTER COOPEY
Engineering Consultant
Charleston, W. Va.

► *Mr. Coopey's comments and the author's reply (below) bring out some interesting points which may be helpful to our readers who have shaft sealing problems of their own.*—ED.

Limits Clearly Stated

Sir:

For Mr. Coopey to infer that we recommend the condensate sealing method irrespective of service conditions is a misinterpretation of the article.

We claimed no universality of application. The article clearly states that we had steam available at a greater pressure than that which the pumps were producing. This is an obvious requirement.

Attaching pump lantern rings directly to water lines is prohibited in many plants and in most city codes; this practice invites all types of cross-connection problems. This is one of the advantages of the steam condensate method. *(Continued)*

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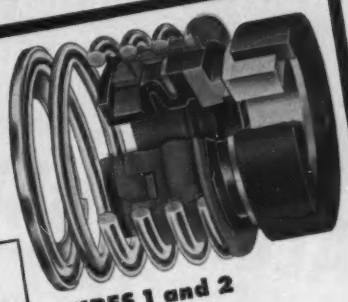

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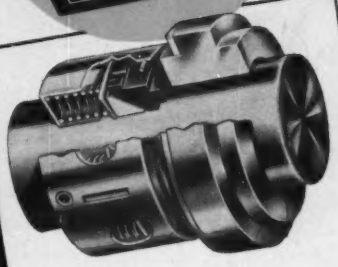

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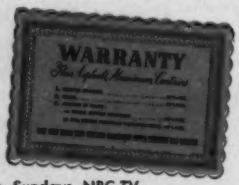

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PRO & CON . . .

The figure of 10 cc./min. indicates only that the amount needed is small. Every case needs its own specific study. Fifteen years ago I operated high-temperature turbine pumps feeding castor oil to the lantern rings, and in that case one drop of oil per sec. was sufficient.

Obviously, if water is a contaminant it cannot be used. As a diluent its effect would depend on the respective flow rates. In our installation the pumps are delivering 20 gpm. of solution; the lantern-ring water represents about 0.01% of the pumping rate.

E. J. GIBBONS
Colgate-Palmolive Co.
Jersey City, N. J.

Pro: Complete References

Sir:

Your five articles reporting on developments disclosed at the Nuclear Congress (Mar. 1956, pp. 114-126) are of extreme interest. The material is very well presented.

However, many interested readers might want the exact titles and appropriate references to the literature so that they could obtain the original papers. I am particularly interested in the heat-transfer paper by Miller, Byrnes and Benforado reported on p. 116. Will you kindly let me know the exact title and literature reference?

FRANK L. RUBIN
Downingtown Iron Works
Downingtown, Pa.

▶ *Many of our readers will remember Mr. Rubin's series of articles in CE dealing with heat exchanger costs. In line with his suggestion, we are listing here the exact titles of the five papers referred to in our Nuclear Congress articles:*

- *Sengstaken, Donald J., and Durham, Edwin, "The Liquid Metal Fuel Reactor for Central Station Power" (Preprint 39).*
- *Miller, Philip, Byrnes, James J., and Benforado, David M., "Heat Transfer to Water Flowing Parallel to a Rod Bundle" (Preprint 47).*
- *Cichelli, M. T., and Boucher, D. F., "Design of Heat-Exchanger Heads for Low Holdup" (Preprint 58).*
- *Hatch, L. P., and Regan, W. H., Jr., "Processing of High-Level Atomic Wastes with the View to Ultimate Disposal" (Preprint 175).*

• *Cygan, R., and Stelle, A. M., "Design and Operation of Freeze Seal Valve and Pumps" (Preprint 82).*

Complete papers can be ordered (by preprint number) from American Institute of Chemical Engineers, 25 W. 45th St., New York, N. Y., for 30¢ each.

The heat-transfer story drew additional reader comment, as per the letter which follows.—ED.

Why a New Correlation?

Sir:

In your March issue (p. 116) appeared an article titled "New Data Fill Vacuum."

I should like to call attention to the fact that Donohue's 1949 article on "Heat Transfer and Pressure Drop in Heat Exchangers" (*Ind. Eng. Chem.*, 41, 2499) discussed a correlation for unbaffled shells (referred to as "parallel flow"). The data of Short, as well as those of Heinrich and Stuckle, were correlated by

$$hD/k = 0.128\ D_e'\ (DG_s/\mu)^{0.6}\ (c\mu/k)^{0.33}$$

with an average deviation of ± 12%.

As Donohue points out, the important point is that the exponent of the Reynolds number (using tube O.D., not hydraulic diameter) is 0.6, and not the 0.8 suggested by several other authors.

Was Donohue's equation considered as a possible basis for correlation?

ABE DEVORE
Davis Engineering Corp.
Elizabeth, N. J.

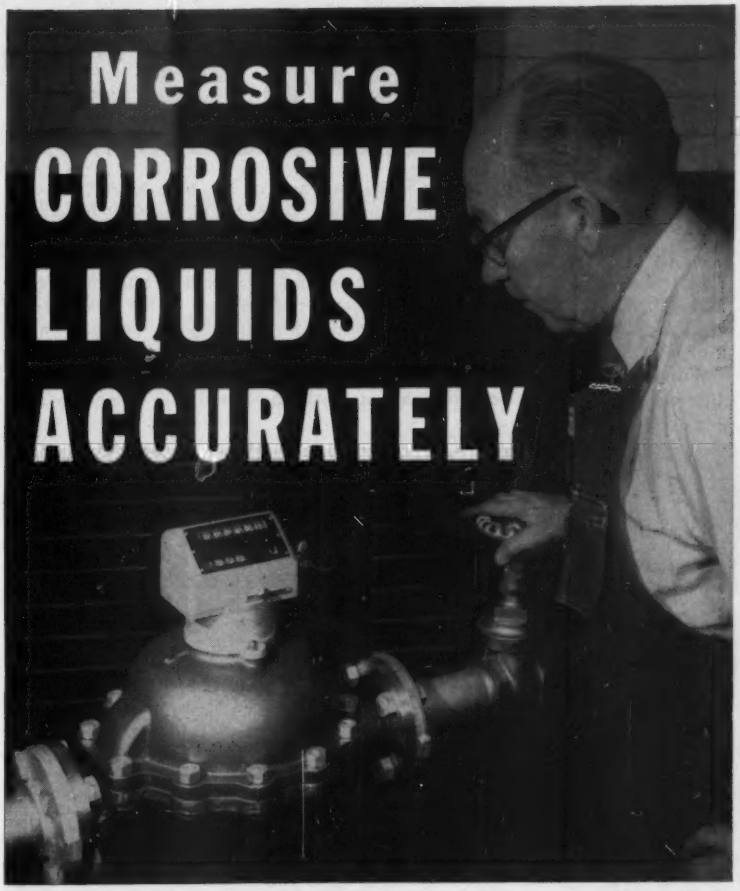
▶ *For the benefit of our many readers interested in heat transfer, we're publishing the authors' answer below.*—ED.

New Data, New Equation

Sir:

The question raised by Mr. Devore was answered in the complete paper as presented at the Nuclear Congress in December. Quoting from our introduction:

"Experimental results have been published on shell-side heat transfer in unbaffled shell-and-tube heat exchangers, and these were correlated by Donohue. However, in these studies the local velocity within the tube bundle was not known, and the



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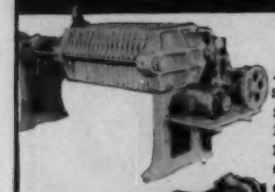

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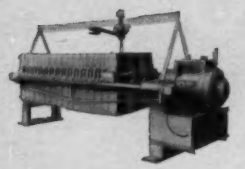

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average velocity was used in the correlation. Because of the considerable space between the tube bundle and the shell, the leakage was undoubtedly sufficient to make the local velocity within the tube bundle much less than the average velocity.

"Presumably on this account Donohue's correlation predicts values of shell-side coefficients that are ½ to ⅓ the values obtained using Eckert's procedure. Consequently, it is not safe to apply Donohue's equation to cases other than shell-and-tube heat exchangers of the type for which the original data were obtained."

To this we might add that, since the diameter was not varied in our experiments, the exponent of the Reynolds number, which we found to be 0.8, would not have been altered by using the tube diameter instead of the hydraulic diameter. Also, since the Donohue correlation was based on data in the Reynolds number range of 1,000 to 10,000, extrapolation to our range of interest of 70,000 to 700,000 with an exponent of 0.6 would account for the low values predicted by the Donohue equation.

PHILIP MILLER
JAMES J. BYRNES
DAVID M. BENFORADO
Walter Kidde Nuclear Laboratories
Garden City, N. Y.

Valuable Time-Saver

Sir:

In the preface to the CE Refresher you say that the series is meant for the man out of school who probably has forgotten some former knowledge.

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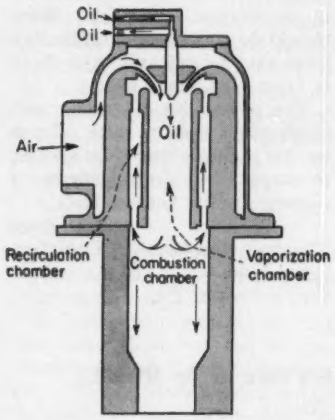
R. F. BAUMANN
Karlsruhe, Germany

▶ *Our files contain comments similar to these which have come from all over the globe. Dr. Corrigan, too, tells us that he has heard from chemical engineers in 15 foreign countries—Australia, Brazil, Canada, Czechoslovakia, England, Germany, Holland, India, Iran, Ireland, Israel, Italy, Mexico, Norway and Switzerland.*—ED.



Pro: Submerged Oil Burner

Sir:

Your article on "Submerged Combustion Flares Anew" (Feb. 1956, pp. 163-7) was well written and presented an honest evaluation of the comparative advantages and disadvantages of submerged-combustion systems in industry. We have found a rapidly increasing interest in the application of submerged combustion to processing problems during the past year.

However, as manufacturers of submerged-combustion heating equipment based on both oil- and gas-fired units, we take partial exception to some of the statements on p. 164. (*Continued*)

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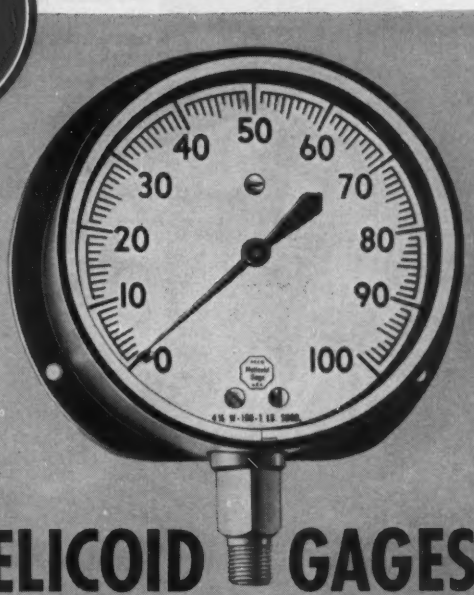

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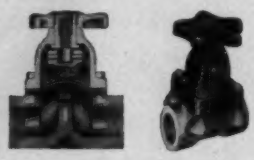

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The possibility of submerged-combustion heating with oil can be very important for specific processes in areas where a gaseous fuel is not available.

R. D. Ross
Thermal Research & Engineering Corp.
Conshohocken, Pa.

It's Nice to Be Missed

Sir:

Thank you for sending me copies of the January and February issues. I still have not received these issues from the Circulation Dept. This is not the first time I have missed a single issue, but one certainly begins to wonder what goes on in McGraw-Hill's Circulation Dept. when two consecutive issues fail to arrive.

Although I sometimes have occasion to refer to older issues of *Chemical Engineering*, nevertheless a great portion of its value is for pertinent, up-to-the-minute news. A two-month gap is more than slightly irritating. This is doubly so in view of the careful processing of requests for subscriptions.

I started following *Chemical*

Engineering about the time that Sid Kirkpatrick first took over. There has been a rather constant improvement in this magazine since that time which I have watched with interest. It would certainly be a disappointment to see a degradation in circulation policies wreck all the good work done by Sid Kirkpatrick and his associates.

A. C. BYRNS
Kaiser Aluminum & Chemical Corp.
Oakland, Calif.

More Data on HNO_3 Plant

Sir:

I have read the article, "New Trend in HNO_3 Plants," in the January issue (pp. 274-7). This article is one of the highlights of the issue.

During the past year or so there have been several articles on this same general subject. This is the first one I remember which discusses in detail the system in which no electric power is directly employed to compress the process air requirements. In the summary of process requirements, some of the data of interest to me were omitted. I am particularly interested in:

1. Anticipated electrical load in the plant.
2. Steam requirements for the steam turbine in the multistage compression.
3. Total cooling water load for the absorption column, cooler-condenser and turbine condensers. (The published value of 800 lb. water per ton 100% HNO_3 is obviously just that consumed in the absorption of the NO_x.)
4. Why is catalyst consumption much lower than in older Du Pont-process plants?

JOHN R. KOEHN
Olin Mathieson Chemical Corp.
Baltimore, Md.

▶ *We're grateful to the firm who designed this plant, Chemical & Industrial Corp., Cincinnati, for furnishing the following data in answer to Mr. Koehn's questions:*

1. 30 *kwh./ton (not including cooling water return pumps).*
2. 25,000 *lb./hr. steam,* 400 *psig.,* 650 *F. at design rate of* 200 *ton/day.*
3. 5,000 *gpm. of* 80 *F. water at design rate.*
4. *C&I uses greater gauze area than was used in the older Du Pont plants.*—ED.

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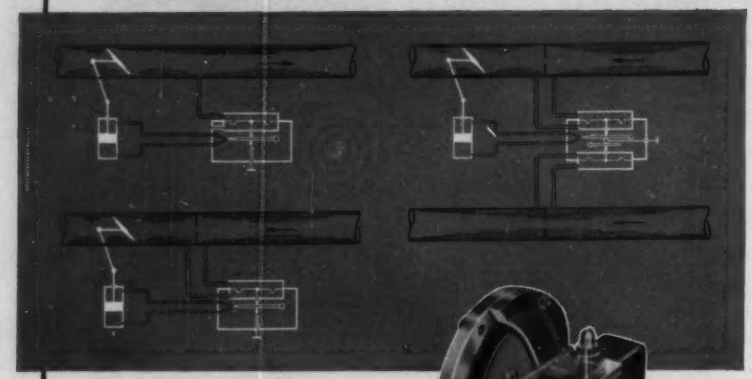

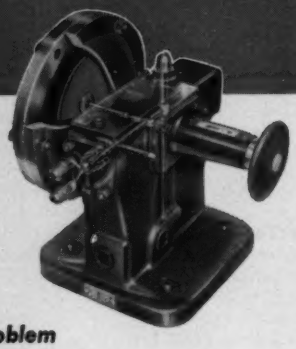

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THIS MONTH'S

Technical

Falls Short of the Mark

FLUIDIZATION. Edited by D. F. Othmer. Reinhold Publishing Corp., New York. 231 pages. $7.

When the Polytechnic Institute of Brooklyn became 100 years old (in 1955), among the series of programs presented to honor the event was a symposium jointly sponsored by the college's chemical engineering department and the New York and New Jersey sections of the AIChE.

Marking so magnificent an accomplishment, the symopsium naturally required a most noteworthy theme. Dr Donald Othmer, head of the Institute's chemical engineering department, wanted one that would suggest the inauguration of a second century of engineering and science education and research.

Fluid-solid contacting via fluid beds was selected. And the compilation of papers presented at the symposium comprises the contents (with the addition of two chapters) of Othmer's book, "Fluidization."

Prepared for an auspicious occasion, the book—in effect—commits itself to something more than the discussion of a promising engineering technique. The implication is that of all the bright stars in the chemical engineering sky the technique of fluidization shines with the greatest brilliance. And around it might be traced a constellation called the future of chemical engineering. But the book does nothing to justify such a view.

Perhaps to compensate for his rather limited topic choice, Othmer and his symposium authors actually have discussed—along with fluid beds—the similar yet distinct technique of moving beds. To keep faith with the title, however, fluid-solid contacting via moving beds is treated with much less emphasis.

The outstanding value of this volume is in its detailed review of formulas, design methods,

Bookshelf

EDITED BY R. K. GITLIN

tables, charts, etc., that have been developed over the years that the technique has progressed from an "art" to an engineering science.

As with many other chemical engineering techniques, fluid and moving bed systems have been in application a great deal longer than have their principles been understood. Empirics and data derived from successful operation of systems, like Topsy, "just grew an' grew."

Diagrams, illustrations, flowsheets, etc. are numerous and excellent. And, for the first time, a reasonably complete bibliography on the subject appears between a single set of covers.

For this reason the book will become an important addition to the library shelves of companies concerned with the design and development of fluid and moving-bed systems.

Nine chapters by outstanding engineers in the field contain enough information from which Othmer might have assembled a fairly definitive text. Instead, he has allowed them to remain a collection of disjointed symposium papers. A loose, informal presentation of the material worked nicely enough at the symposium. But between the covers of a book the reader is entitled to a more organized, consistent, continuous presentation from the editor.

Obvious kick-off material such as the history of the technique doesn't appear until the fourth chapter (by E. J. Gohr of Esso). Robert Benanati and Ju Chin Chu, chemical engineering professors at Brooklyn Poly, ostensibly open the book with two chapters concerned with fundamentals. They stick to the title subject, fluidization, seemingly unaware that the subject of moving beds is to be introduced further along.

F. A. Zenz of Kellogg moves in the moving bed during his discussion (third chapter) of a graphical analysis of fluid-solid systems. And C. Berg (Union Oil of Calif.) devotes his seventh

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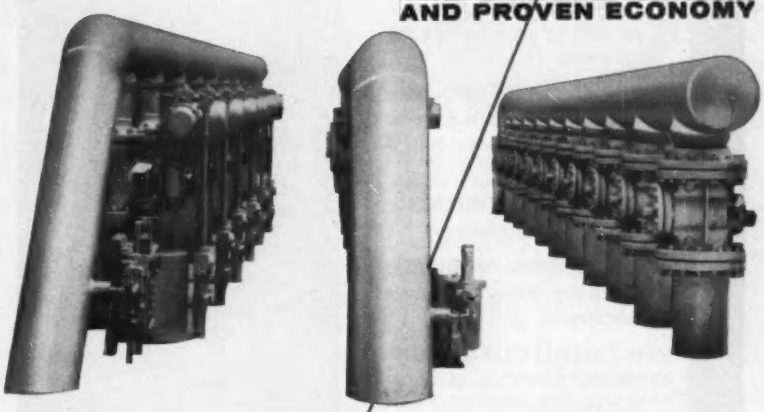

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chapter to their design and control.

Two specific applications of fluid beds—fluid coking and catalytic cracking—are interspersed through the volume. And potential utilizations (a good wind-up chapter) are predicted somewhere in the middle. Nomenclature differs from chapter to chapter and material frequently overlaps with the repetition of details. (How often is it necessary to draw the analogy between fluid beds and boiling liquids in order to drive the point home?)

At $7 for 231 pages, all this comes pretty high. But perhaps there is some justification for the cost. The contributing authors have donated their literary rights (revealed in the preface) to the Polytechnic Development Fund. This fund is now in the process of building a new, larger, more completely equipped college facility. With it Brooklyn Poly will be able to press forward in its second century of "Science-Engineering Research for Human Well Being."—TPF

Guide to P. E. Exam

PROFESSIONAL ENGINEER'S EXAMINATION QUESTIONS AND ANSWERS, By W. S. La Londe, Jr. McGraw-Hill Book Co., New York, 462 pages. $6.50.

In the words of the author, "This book has been prepared to help both the newly graduated engineer and the older practicing engineer in their review of engineering fundamentals in preparation for the professional engineer examinations as part requirement for the engineer-in-training or the professional engineer license." And as a guide—but only as a guide—it certainly fills the bill.

Over 800 questions selected from recent state examinations cover all major phases of the engineering sciences. Some are composites of complex questions given in exams all over the U. S.

Better than 70% of the questions deal with basic fundamentals—chemistry, materials, electricity, hydraulics, math and measurements, mechanics (kinetics and statics), thermodynamics. The rest are geared to

specific engineering specialties —chemical, civil, electrical, mechanical, structural, land surveying.

For every question there is a detailed answer of the type which state examiners would accept and credit.

Rounding out the fund of information presented is a general section (actually an introduction) which discusses legal registration, model laws for registration, suggested experience qualification guide and lists addresses of state registration boards.

As we mentioned earlier, this volume is fine as a guide for both the instructor in a P.E. refresher course and for the home-study student. (It may also serve as a source of problems in undergraduate and graduate courses.) But, in any case, be prepared to use it in conjunction with the "bibles" of the profession.

Chemical engineers, particularly those who may have forgotten time-worn formulas, thermodynamic laws, conventional process descriptions, will find it necessary to have books like Perry, Shreve, Dodge, etc. close at hand while working out the problems.—RKG

Fundamentals, For a Change

PROCEEDINGS OF THE SIXTH MEETING OF THE INTERNATIONAL COMMITTEE FOR ELECTROCHEMICAL THERMODYNAMICS AND KINETICS. Butterworths Scientific Publications, London. 567 pages. 84 shillings.

Reviewed by M. Kolodney

This weighty volume reports the administrative proceedings and the technical papers presented at the Paris conference on Electrochemical Thermodynamics and Kinetics held in September, 1954. Fifty participants represented 15 countries and some 40 organizations. In terms of number of representatives, the United States had a poor showing.

The Committee has set up an ambitious program of study of the principles and applications of electrochemistry. In the

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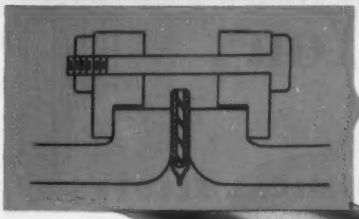

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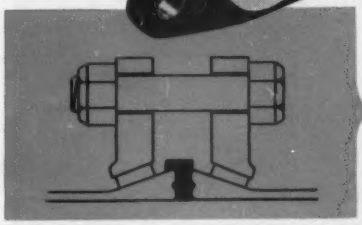

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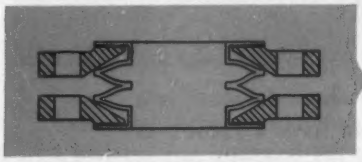

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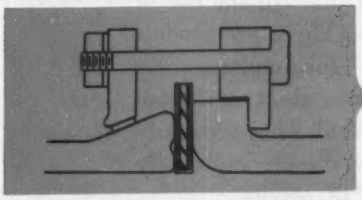

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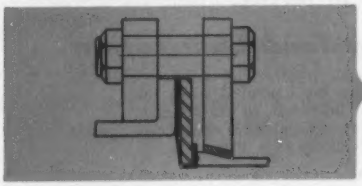

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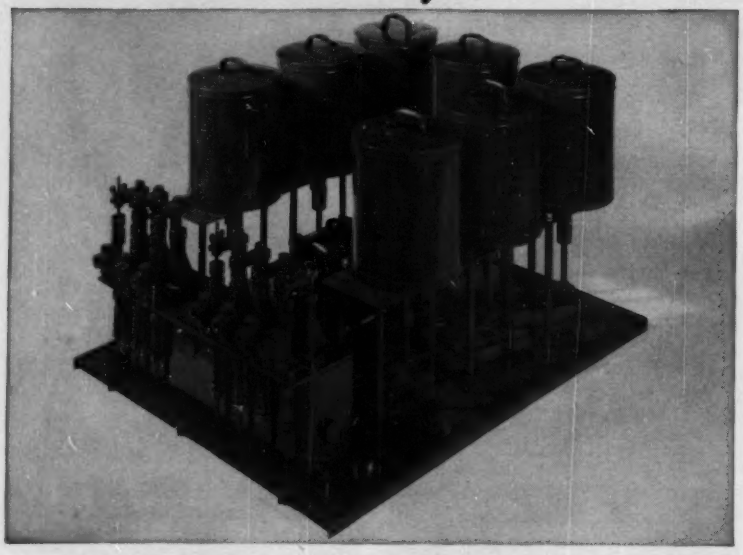

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former group are included nomenclature and definitions, experimental methods and electrochemical behavior of metals and non-metals.

Applied studies comprise corrosion, primary and secondary cells, as well as electrolytic processes. Lest any industrial electrochemist be misled, one must hasten to add that even the papers on applications of electrochemistry are theoretical in nature.

In fact, the International Committee seems determined to devote its work almost exclusively to fundamental investigations. And this attitude is highly encouraging.

Unfortunately, during the past decade much of the research in the U. S. and elsewhere has been aimed at development and engineering instead of an understanding of nature. Therefore it's refreshing to find a volume such as this with few "practical" applications, but one that will repay perusal by anyone working or interested in electrochemistry.

BRIEFLY NOTED

FUNCTION AND TRAINING OF THE CHEMICAL ENGINEER. 85 *pages.* $1.25. *European Productivity Agency of the Organization for European Economic Cooperation, 2 Rue Andre-Pascal, Paris 16, France.* Reprint of 31 papers presented at an international conference held in London, March 21-23, 1955. Papers are classified into six broad categories (presented at six separate conference sessions): Part played by the chemical engineer in bridging the gap between research and plant construction, chemical engineer in plant operation and management, model course of study for a primary degree in chemical engineering, other education schemes in chemical engineering, practical training of the chemical engineer before and after entry into industry, chemical engineering—its future needs and scope.

DISTRIBUTION OF OVEN AND BEEHIVE COKE IN 1954. 40 *pages. Prepared by E. T. Sheridan, et al. U. S. Dept. of Interior, Bureau of Mines, Washington 25, D. C.* Mainly charts and tables of distribution of oven and beehive coke by use, geographic regions,

state, consumption, production, etc.

RADIOACTIVE DEPOSITS IN CALIFORNIA. 38 *pages.* 50¢. *By G. W. Walker, et al. Division of Mines, Perry Building, San Francisco 11, Calif.* Reports on distribution, size, shape, mineralogy and economic evaluation of uranium and thorium deposits in California. Offers suggestions for prospecting both radioactive elements. Six maps locating deposits accompany the text.

PROCEEDINGS OF THE NINTH ANNUAL MEETING OF THE INDUSTRY-FACULTY CONFERENCE OF LOUISIANA, MARCH 31-APRIL 1, 1955. 79 *pages.* $1. *Engineering Experiment Station, Louisiana State University, Baton Rouge 3, La.* Reprint of talks and discussions on the theme, "The Engineering School, The Engineer and Industrial Development." Subject is covered from three angles—the viewpoint of an educator, of industry and of an associated organization.

REVIEW FOR ENGINEERING REGISTRATION—1. FUNDAMENTALS SECTION. 52 *pages.* 60¢. *By L. A. Clayton. Engineering Experiment Station, Oregon State College, Corvallis, Ore.* Covers basic mathematics, statics, dynamics, energy relationships, strength of materials, electricity. Sample problems and solutions accompany each section.

ASTM STANDARDS ON PETROLEUM PRODUCTS AND LUBRICANTS. 950 *pages.* $7.15 (cloth-bound), $6.50 (*paper-bound*). *American Society for Testing Materials,* 1916 *Race St., Philadelphia 3, Pa.* Special compilation including tentative and standard test methods, specifications, definitions of terms and classifications of petroleum products and lubricants, plus related information. Among the new tentative test methods are those for lubricating qualities of graphites and trace concentrations of tetraethyl lead in primary reference fuels. New standard test-methods are presented for aromatic hydrocarbons in olefin-free gasolines, oxygen in butadiene vapors, effect of grease on copper, lead in new and used greases, sampling liquefied petroleum gases, unsaturated light hydrocarbons.

THE STORY OF SERPASIL. 55 *pages. Ciba Pharmaceutical Products Inc., Summit, N. J.* A five-part story of the history, isolation, clinical testing and manufacture

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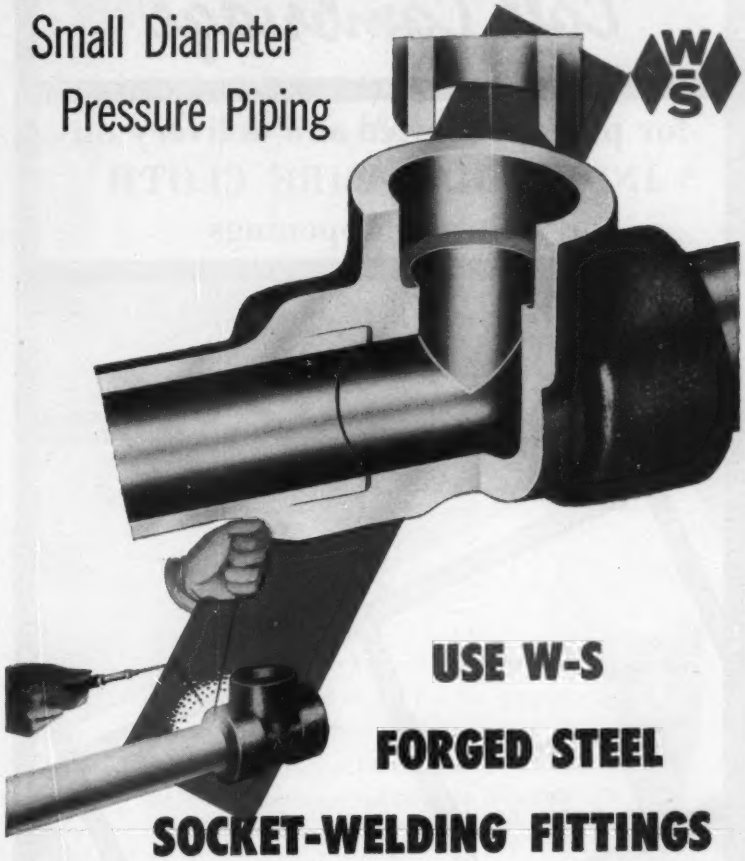

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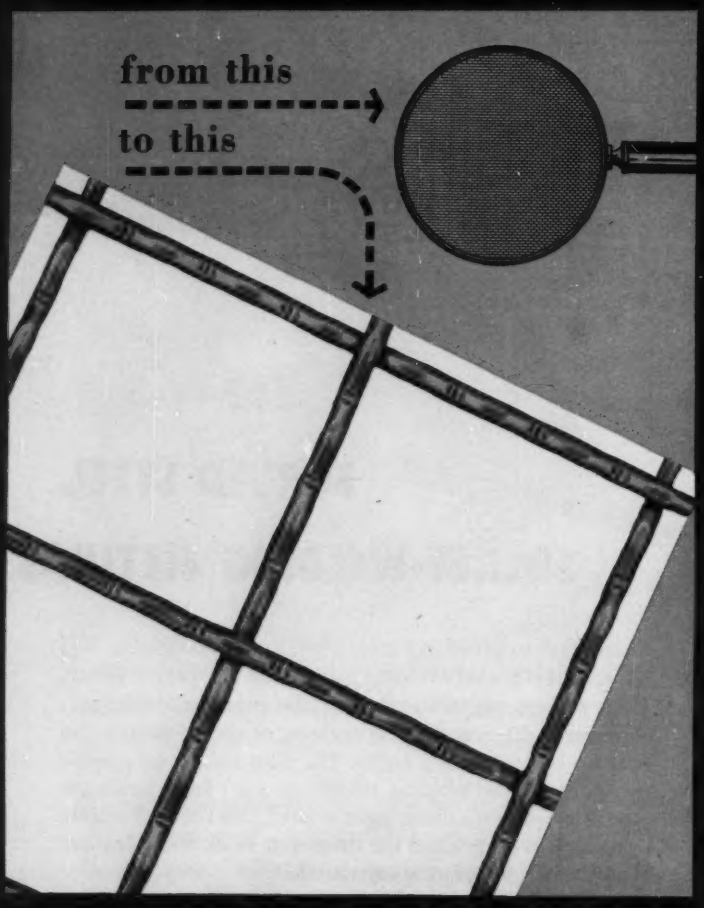

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EARTHQUAKES IN KERN COUNTY, CALIFORNIA DURING 1952. 283 *pages.* $4. *Edited by G. B. Oakeshott. Division of Mines, Ferry Building, San Francisco* 11, *Calif.* A symposium on the stratigraphy, structural geology and origin of the earthquakes; their geologic effects, seismologic measurements, application of seismology to petroleum exploration; structural damage and design of earthquake-resistant structures.

INTERCHANGEABILITY OF HIGH-BTU. OIL GASES AND NATURAL GASES. 59 *pages.* $5. *By E. F. Searight, et al. Institute of Gas Technology, Technology Center, Chicago* 16, *Ill.* Offers an answer to problems faced by distribution companies which must supplement their natural gas supplies to meet peak loads. Study shows effect of operating conditions and modification with diluents on the substitutability of oil gases. It also reports maximum percent oil gas in mixtures of oil gas and base natural gas which exhibited satisfactory combustion performance on critical burners and critical and contemporary appliances.

EQUILIBRIUM MOISTURE CONTENT OF NATURAL GASES. 19 *pages.* $3. *By R. F. Bukacek. Institute of Gas Technology, Technology Center, Chicago* 16, *Ill.* Presents measurements of moisture contents of methane, propane, nitrogen, a methane-propane mixture, two methane-butane mixtures, a methane-pentane mixture, nitrogen-free and high-nitrogen (14.8%) natural gases at 220 F. and in the 1,000-10,000 psi. pressure range. Also includes a newly developed correlation for determining equilibrium moisture content of any natural gas.

PARALLEL GLASS FIBRE REINFORCEMENT FOR PLASTIC LAMINATES. 32 *pages.* $1. *Final report, Firestone Tire & Rubber Co. for Bureau of Ordnance, March,* 1955. *Office of Technical Services U. S. Dept. of Commerce, Washington* 25, *D. C.* Describes materials, processes and experiments in the molding and testing of parallel glass fibres into edges and corners, honeycomb sandwich construction, reinforced plastic tubing, body armor.

ELEVATED-TEMPERATURE PROPERTIES OF CARBON STEELS. 63 *pages.* $3.75. *American Society for Testing Materials,* 1916 *Race St., Philadelphia* 3, *Pa.* Includes data for tensile and yield strength, elongation and reduction of area, stresses for creep rates of 0.0001 and 0.00001 percent per hr. and rupture strength for 100, 1,000, 10,000 and 100,000 hr. Properties are given in graphical form and supplemented by copies of original data sheets from those contributing data.

ASTM STANDARDS ON PAPER AND PAPER PRODUCTS AND SHIPPING CONTAINERS. 394 *pages.* $3.75. *American Society for Testing Materials,* 1916 *Race St., Philadelphia* 3, *Pa.* Compilation includes ASTM standard and tentative specifications, test methods, definitions of terms pertaining to paper, paper products and shipping containers. Total of 101 designations contains five new standards and ten which have been revised since the previous edition (1953). Added to standards are seven appendices, four of which are new.

GEOLOGY OF A PORTION OF THE ELSINORE FAULT ZONE, CALIFORNIA. 22 *pages.* 75¢. *By J. F. Mann, Jr. Division of Mines, Ferry Building, San Francisco* 11, *Calif.* Includes discussion of physiography, stratigraphy, structure and mineral resources of the Temecular region in western Riverside and northern San Diego counties in southwestern California. Geologic map and drawings of the region's structure sections are included in the report.

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ELECTRONS—THE SCIENCE OF ELECTRONS IN ACTION. By A. W. Keen. Philosophical Library. $7.50.

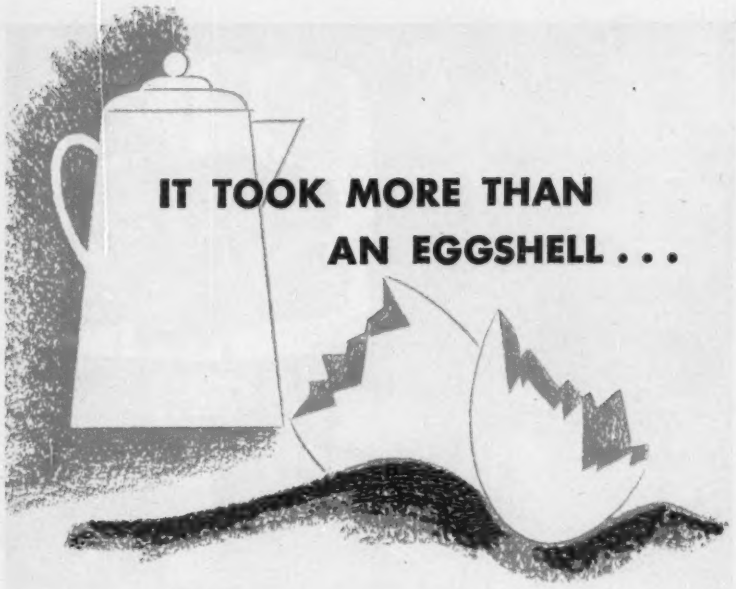
ELECTRONS, WAVES AND MESSAGES—THE ART AND SCIENCE OF MODERN ELECTRONICS. By J. R. Pierce. Hanover House. $5.

MECHANISM OF ORGANIC CHEMICAL REACTIONS. By E. de Barry Barnett. Interscience. $4.75.

PLASTICS TECHNICAL DICTIONARY. English-German. By A. M. Wittfoht. Hanser Verlag.

POLYMER PROCESSES. High Polymers, Vol. 10. Edited by C. E. Schildknecht. Interscience. $19.50.

REDUCTION WITH COMPLEX METAL HYDRIDES. By N. G. Gaylord. Interscience. $15.



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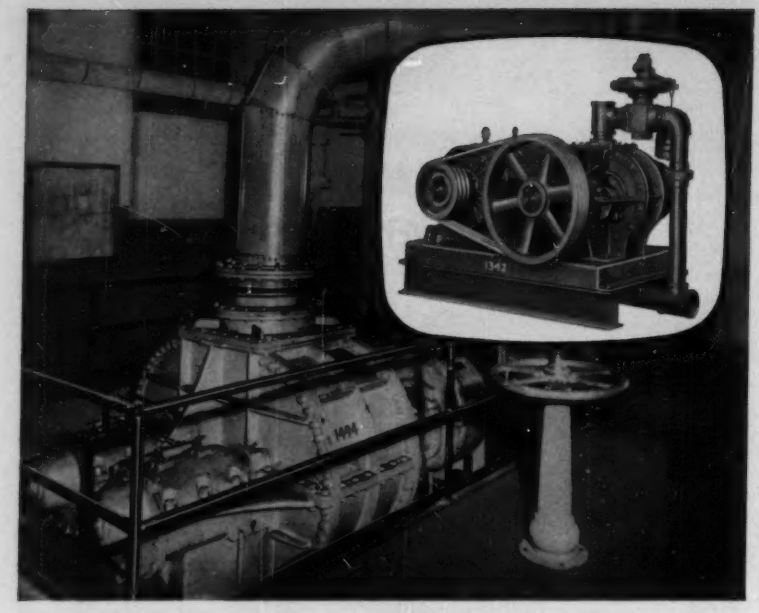

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Spiraxial® Compressors

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Detailed bulletins available on all R-C equipment.

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A DIVISION OF DRESSER INDUSTRIES, INC.

556 Illinois Ave. Connersville, Indiana. In Canada, 629 Adelaide St. W., Toronto, Ont.

THIS MONTH'S

Firms in

New Lines

Carpenter Steel Co.'s alloy tube division is now marketing its first non-metallic product: rigid unplasticized polyvinyl chloride pipe for use in the chemical and other process industries.

Beckman Instruments, Inc. has expanded its line of mechanical and electromechanical components through the acquisition of Belock Instrument Corp. of New York. Belock's products include high speed magnetic clutches, servo motor gear heads and other servo system elements.

Orangeburg Mfg. Co., manufacturer of electrical fiber conduit and bituminized-fiber sewer pipe, is entering the plastic pipe field. The new product will be made at a plant almost completed in Orangeburg, N. Y.

American Lava Corp. has started production at its Chattanooga, Tenn., plant of alumina ceramics, reportedly harder, stronger and more resistant to heat than technical ceramics. The company has also started making high-temperature metal-ceramic combinations in which the metal is fused into the ceramic and becomes an integral part of it.

Flintkote Co. has acquired a line of acoustical, insulating, fireproof building material through the purchase of the Insulrock Corp.

New Representatives

Mission Mfg. Co. has appointed MacGregor-Sears Co., St. Louis, Mo., as distributor for its line of centrifugal pumps.

Celanese Corp. and Bakelite Co. have appointed Cadillac Plastic and Chemical Co. as distributor of their Marco polyester resins and Krene flexible vinyl material respectively.

the News

EDITED BY F. ARNE

M. W. Kellogg Co. has appointed the Saint-Gobain Co. exclusive agent in France and Spain for the sale of its line of fluoro-carbon products.

New Locations

Colorado Fuel & Iron Corp. has moved its Chicago district sales office and warehouse to 3838 West 51st St.

Dow Chemical Co. has moved its Philadelphia office to 400 Market St., Camden, N. J.

Link-Belt Co. has moved its executive offices to Prudential Plaza, Chicago.

M. W. Kellogg Co. is moving to 711 Third Ave., New York.

Concord Chemical Co., which has recently acquired the Standard Soap Co. of Camden, N. J., is moving its entire operations from Moorestown, N. J., to Camden.

New Companies

Du Pont de Venezuela, C. A., Caracas, has been formed to produce finishes for the Venezuelan market. The company is about to start operation of a new plant near Caracus.

Cutter-Quimica Argentine has been formed by Cutter Laboratories, Inc., Berkeley, Calif,. and Serum-Quimica Argentine of Buenos Aires to produce medical products for Argentina.

Indiana Commercial Filters Corp. has been formed by Commercial Filters Corp., Melrose, Mass., to handle new filter lines acquired through its recent purchase of Houdaille-Hershey of Indiana, Inc., and the filter division of Michiana Products Corp.

D. Q. Kern Associates, Cleveland, has been formed to specialize in thermal process technology. With branches in New York and Washington, D. C., the new firm will emphasize design, engineering

AUTO-LITE

for EYE LEVEL READING

Auto-Lite Temperature Indicators are ideal for use in processing and storage rooms, and for installation on equipment where temperature indication is desirable.

Model F-1 (illustrated) is available with maximum visibility dial; choice of temperature ranges from minus 60°F to plus 750°F; flexible tubing for remote reading or rigid stem for direct mounting. Adjustable electrical alarm contacts slightly higher. Priced from $22.

Send for new catalog describing Auto-Lite Temperature Indicators and Recorders.

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improved flow conditions
on your stainless steel piping installations
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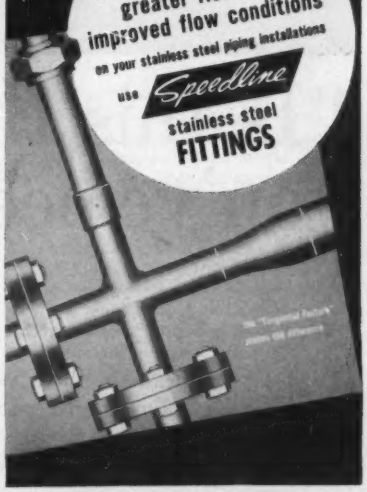

Distributors are located in principal cities from coast to coast

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STAINLESS STEEL FITTINGS
manufactured by HORACE T. POTTS COMPANY
500 East Erie Avenue • Philadelphia 34, Pa.

"Is this that Pritchard Hydryer® you've been raving about, Ben?"

"Yes, and isn't it a honey?"

"You're pretty happy about it aren't you?"

"You bet I am. Remember those few months before we got our Hydryer? Those nights and weekends we had to work trying to keep all those precision instruments operating. If it wasn't moisture that was fouling things up, it was corrosion."

"I remember only too well. Say, Ben, how did you get a line on that Pritchard Hydryer in the first place?"

"I sent for a copy of their bulletin on the Hydryer. After I read it I talked it over with the chief and we ordered ours. You know this unit does everything their literature said it would. Right now we're pulling 63 pounds of water from our instrument air every day. It dries 160 SCFM at 100-psig., and 90°F."

"All I know is that things are a lot different around here since we put that Hydryer in. C'mon, let's go home. That air is in good hands."

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4625 Roanoke Parkway, Kansas City 12, Mo.

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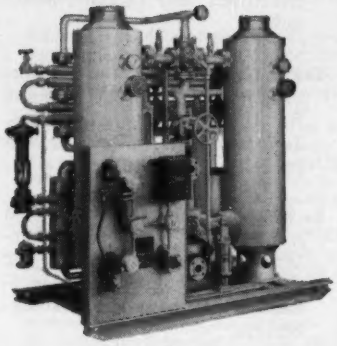

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The PRITCHARD HYDRYER* DELIVERS IT!

The Pritchard HYDRYER is a low-cost, packaged dehydration unit. It is ideally suited for use with precision instruments. The HYDRYER effectively removes moisture from air, carbon dioxide, synthesis gas and many other gases.

These exclusive design features make the HYDRYER superior to any other such unit on the market today:

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REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST

FIRMS . . .

and marketing of thermal process components.

Whitman Laboratories, Norwich, N. Y., has been formed to manufacture and sell chemicals and food products, initially concentrating on the industrial chemical field.

New Names

Endo Products Inc., Richmond Hill, N. Y., has changed its name to Endo Laboratories Inc.

Trundle Engineering Co., Cleveland, has changed its name to Trundle Consultants Inc.

Haas Miller Corp., Philadelphia manufacturer of industrial chemicals for the textile, leather, paper and plastic industries, has changed its name to Harry Miller Corp.

Stauffer Chemical Co. has changed the name of its Western-Pacific container division to the molded products division. Based at Vernon, Calif., the division makes hard rubber and plastic parts and molded products.

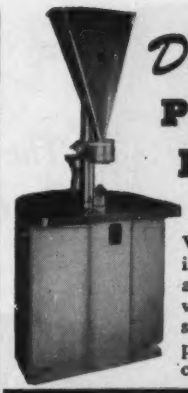
Rowe Paint & Varnish Co., Niagara Falls, N. Y., has changed its name to Rowe Products Inc. to accommodate the company's broadened line of products which include protective coatings, chlorine cell putties and industrial mastics.

American Maintenance Supply Co., Chicago manufacturer of Detero Wax Beads, has changed its name to Arrow Laboratories.

New Facilities

Texas Eastman Co. is increasing capacity of its polyethylene plastic plant in Longview, Tex., to 40 million lb./yr.

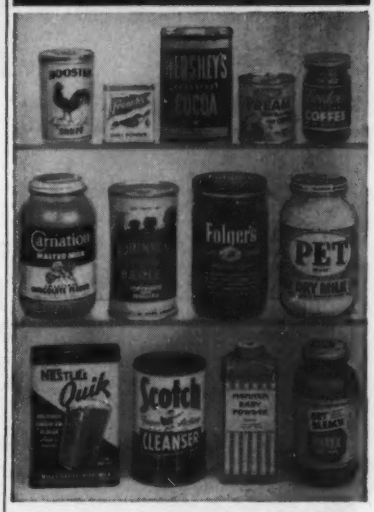
Reynolds Metals Co. will spend from $25-30 million for immediate expansion of its La Quinta, Tex., alumina plant. Production, increased by more than 50 percent, will be over 1,500 tons/day. This is part of a $43 million program which will include an en-



Dustless **POWDER FILLING**

Vacuflow powder filling equipment operates on a principle of vacuum feeding, instead of pressure, to pack powder into a container.

VACUFLOW



Air is removed from the container to create a vacuum which draws a measured quantity of powder from the hopper. There is no problem with dust control, since the unique Vacuflow method simply does not involve air currents that cause dust.

Semi-automatic models are available for filling containers ranging from the tiny talcum box up to and including 100 lb. paper bags and 200 lb. drums. Rotary models are available for automatic production of 5 lb. sizes or less at speeds of 45 to 300 per minute.

Pneumatic is the one manufacturer in a position to furnish machines for making up complete production lines. Units are available for air cleaning, powder and liquid filling, capping and labeling a wide range of bottles, cans or jars.

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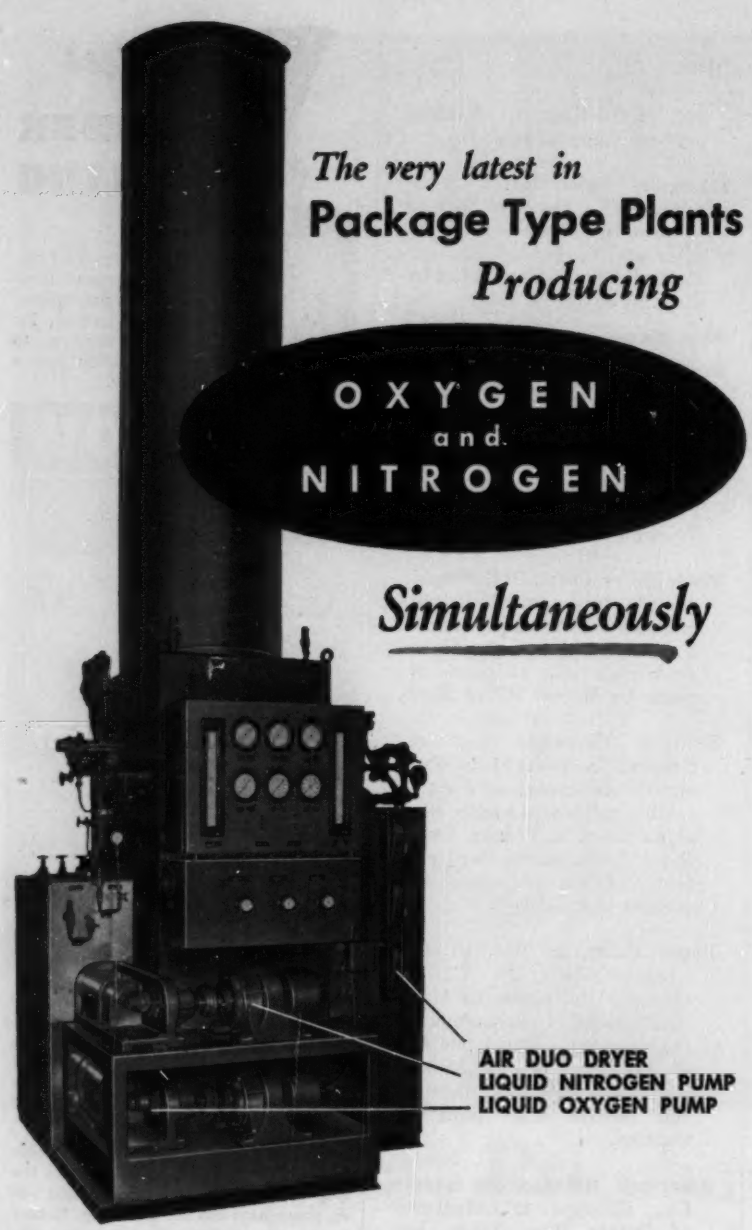
The very latest in

Package Type Plants

Producing

OXYGEN and NITROGEN

Simultaneously



With the introduction of our latest, improved design Package Type Generating Plants, production of high purity Oxygen and Nitrogen simultaneously *increases* production 60% over the production of Oxygen alone, *plus* a corresponding reduction in the *cost* of manufacture. Due to its compact design, a minimum of floor space is required and streamlined panel assembly insures instant visibility of all control gauges. Stock sizes from 1500 to 10,000 cu. ft. per hour. Larger and smaller sizes available. 99.99% Argon available on large size plants.

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CYLINDERS AND GAS PRODUCING EQUIPMENT
ACETYLENE · OXYGEN · HYDROGEN · NITROGEN

O'FALLON, 7 ILLINOIS

FIRMS . . .

largement of the aluminum sheet rolling plant at Sheffield, Ala.

Nopco Chemical Co. has just about completed a pilot plant in Harrison, N. J., for development work on industrial chemicals and vitamin products.

Texas Gulf Sulphur Co. is planning a sulfur extraction plant for the Fannett Salt Dome, Jefferson County, Tex. Frasch process will be used.

L. Sonneborn Sons has opened a plant and sales headquarters in Toronto, Canada, for its line of building maintenance and construction materials.

North American Cyanamid Ltd. will complete a xanthate plant in Port Robinson, Ont., before the end of the year. At the same location, capacity for producing nitrogen solution will be doubled, anhydrous ammonia capacity will be increased.

U. S. Oil & Refining Co. plans a $10-million oil refinery for Long Beach, Calif. To be completed by summer of 1957, the plant will have a 25,000 bbl./day capacity.

Allied Chemical & Dye Corp.'s nitrogen division will install plant facilities at Hopewell, Va., for the production of solid ammonium nitrate. They will be completed by the end of 1956.

Ultra Chemical Works, Inc., Paterson, N. J., has completed a $250,000 plant addition to boost production in its organic chemical department.

B. L. Lemke & Co. has completed a new manufacturing unit for production of calcium, potassium and sodium propionate with capacity of over 500,000 lb./yr.

B. F. Goodrich Co. has re-established new and modern facilities at Los Angeles for manufacture of rubber fuel cells, which it discontinued after World War II. Production

1ST

In Reliability
Efficiency
Ease of Maintenance

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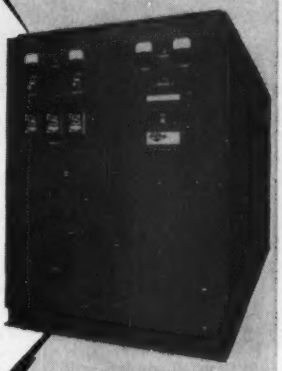
GERMANIUM RECTIFIERS



Millions of hours of dependable service from thousands of SEL-REX RECTIFIERS throughout the world, have established SEL-REX as the standard of the industry. NOW — SEL-REX GERMANIUM RECTIFIERS offer *efficiency up to 96%*. You get this initial extra-high efficiency for the life of the unit, because GERMANIUM has shown no chemical deterioration in over six years of testing and experimentation. As with all SEL-REX RECTIFIERS, SEL-REX GERMANIUM RECTIFIERS are "custom engineered" to your specific requirements . . . available in either air or water cooled models, with all types of fully automatic and remote controls. Nothing to wear or get out of order — only the cooling fan is in motion — SEL-REX "custom engineering" has reduced maintenance to the absolute minimum.

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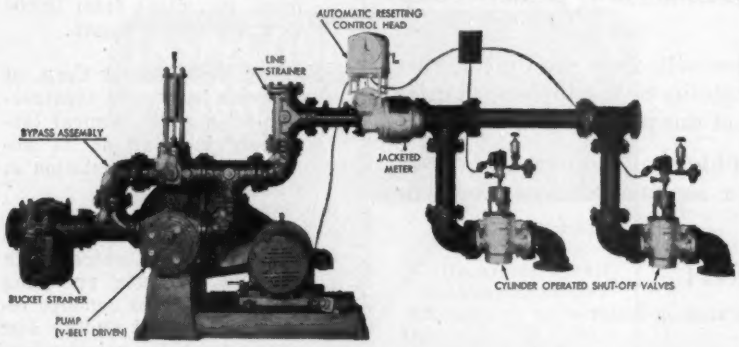
Sel-Rex units from 25 up to 50,000 amperes



TYPICAL MULTI-VALVE FLUIDOMETER SYSTEM

for a more flexible production schedule

ANYTHING

that can be handled through a meter can be accurately and economically batched by the

FLUIDOMETER

Multi-valve Fluidometer systems make possible a more flexible production schedule by varying the size of the batches, or by using the automatic resetting control to deliver the same quantity time after time. A multi-valve Fluidometer system may be controlled either at the point of use or at the Fluidometer control head. Fluidometer installations are available either jacketed or unjacketed and are "tailor made" to fit the particular job. Tell us your batching problem and let us give you our suggestions for solving it.

Bulletin Fl-56 will be sent on request. For information on jacketed pipe and fittings write for Bulletin J-56.

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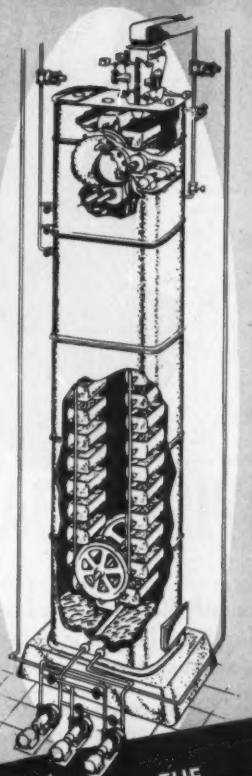
FRENCH

BASKET TYPE EXTRACTOR



IDEAL FOR THE EXTRACTION OF SOLIDS

- Developed and perfected by more than 50 years of application in the oil milling industry.
- Over 50 operating plants producing top quality product with low operating and maintenance costs.
- Standard sizes range from 25 tons to 1000 tons per day capacity.
- Let French help you solve extraction problems involving solids. Write today to French, Extraction Division, Piqua, Ohio.

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"BUFFALO" PUMP FOR YOUR HEAT TRANSFER LIQUIDS

"Buffalo" Pump recently furnished to large aircraft firm for handling high temperature oil.

Specially designed for handling the high-temperature liquids now being used in vapor phase heat transfer, this new "Buffalo" Pump has already proved its reliability.

The "Q" Factor* features listed below will show you the care that has gone into its construction. For ability to handle heat transfer liquids efficiently, the performance of this pump is assured.

If you are concerned with a problem of heat transfer by a liquid medium, write us today for recommendations from our Engineering Department.

These Quality Features!

1. Extra-deep water-cooled stuffing boxes
2. Smothering gland
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6. Flexible all steel coupling
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**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo" PUMPS

BUFFALO PUMPS

DIVISION OF BUFFALO FORGE COMPANY

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Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

FIRMS . . .

goes to aircraft and military vehicles.

Oregon Portland Cement Co. has begun construction of a $3-million expansion of its plant at Lime, Ore. Annual capacity, which will be doubled, will come to 1 million bbl. of finished cement.

Shawinigan Resins Corp. is building a plant, at Trenton, Mich., to be completed by year's end, which will make polyvinyl butyral.

H. K. Ferguson Co., Cleveland, has established a separate group to supervise design and construction projects in the field of atomic energy.

Mississippi River Fuel Corp.'s new 140,000-ton/yr. ammonium nitrate plant at Selma, Mo., has commenced operations.

St. Joseph Lead Co. plans to increase refined zinc producing capacity at its Josephtown, Pa., plant from 10,000 to 12,000 tons a month.

Nuclear Development Corp. of America has begun construction of a radiochemical laboratory building at its nuclear experimental station in Pawling, N. Y.

Climax Molybdenum Co. has made a one-year contract with Battelle Institute providing for the latter to conduct research aimed at finding new applications for existing molybdenum chemicals.

Union Carbide Development Co. has been formed as a new division of Union Carbide and Carbon Corp. to handle long-term corporate planning and evaluation of new business opportunities.

Texas Glass Mfg. Corp. has been formed in Houston to manufacture 83 tons/day of finished glass at an $1.8-million plant to be built in Bryan, Tex.

Caribe General Electric, Inc. has been formed by General Electric to operate a plant in

METAL FABRICATING

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Nickel pipe fabricated for the chemical industry

More accurate and faster metal fabricating is yours at Littleford . . . because (1) our engineers work closely with your engineers. (2) 175,000 sq. ft. of modern plant and equipment are devoted to the production of your tanks, bins, vats, troughs, carts, ducts and special units. In addition, you get the advantage of over 73 years experience in metal fabricating including stainless steel, aluminum, nickel and monel. For prompt estimates, send your blueprints to Littleford Bros., 421 E. Pearl St., Cincinnati 2, Ohio.

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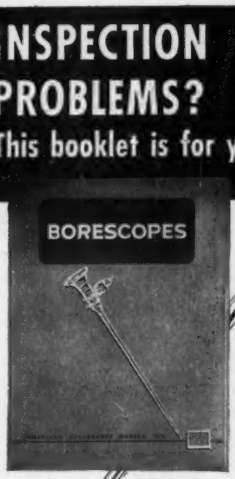
This booklet is for you!



This comprehensive, elaborately illustrated booklet provides practical information on the use of the famous A. C. M. I. Borescope in various industries, for the inspection of interior areas or surfaces not otherwise visible—together with full data on the types of Borescope available, and on their care and maintenance. Have you received your copy?

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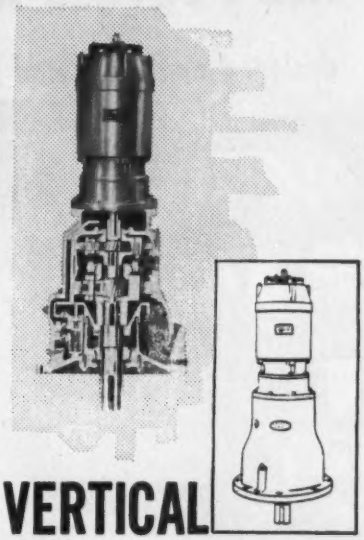

VERTICAL SHAFT DRIVE

For a compact, neat and sturdy self-contained Vertical Speed Reducer, the Philadelphia **MotoReduceR** is tops in design, construction and operation. The unique single casing and bolted-on motor construction . . . makes mounting and installation very simple, and of course, it eliminates base plates and couplings. The planetary, in-line reduction gears provide a rugged drive capable of withstanding severe overload conditions . . . Other features are: wide bearing span, permitting use of long, unsupported vertical shafts; Exclusive "dry-well" construction, which prevents oil leaking down output shaft.

Philadelphia MotoReduceRs can be supplied for output speeds from 9 R.P.M. to 420 R.P.M. with standard motor speeds . . . Units up to 100 H.P. are available—and a full range of horizontal units can also be supplied.

For complete information, send for 32 page Catalog MR-54

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Established 1892

Pelletizing Drums for the Process Industries ★

designed and fabricated by

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This metal fabrication "know-how" can be applied to a variety of metals, including stainless steel, carbon steel, clad steels, wrought iron and aluminum. Whatever the type metal, BOARDMAN facilities are ready to serve you.

YOUR key to quality metal fabrication is . . .

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OKLAHOMA CITY
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BRANCH OFFICE: TULSA, OKLAHOMA

FIRMS . . .

Palmer, Puerto Rico, for the manufacture of low voltage electrical distribution protective and disconnect devices.

Anaconda Co. will spend $53 million on expansion of mining and refining facilities for copper deposits near Indio Muerto Mountain in Chile. Expected annual capacity is 100,000 short tons of fine copper. A plant for recovery of byproduct molybdenum is also planned.

General American Transportation Corp.'s plastics division will build a research and development laboratory in East Chicago, Ind. Completion is set for early summer.

Farbenfabriken Bayer A.G. of Leverkusen, Germany, is building a $24-million titanium dioxide plant. To be in operation by the end of 1957, it will cover the entire West German demand.

Colgate-Palmolive Co. plans to build a multi-million dollar research center in Bloomfield, N. J.

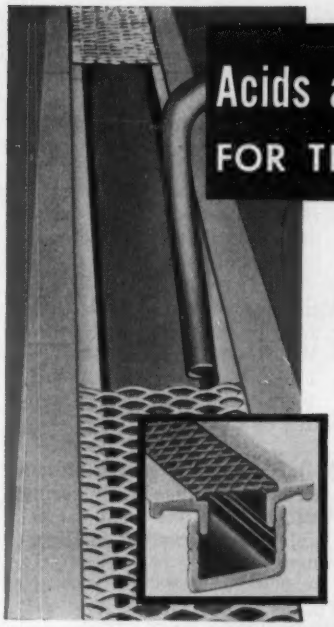
Procter & Gamble Co. of Canada, Ltd. is building a multi-million dollar plant in the Montreal area for processing shortening and edible oils. It will augment production of the company's Hamilton, Ont., plant by 25%.

Standard Oil Co. (Indiana) plans to complete a new four-unit lubricating oil plant at its Casper, Wyo., refinery by May of 1957.

Dow Chemical Co. is now running its two magnesium metals plants in Freeport and Velasco, Tex., at full capacity (75,000 tons/yr.) for the first time in recent years.

McDowell Co. at Eagle Mills, Mich., is intalling a complete iron ore agglomerating plant, which it designed, including the various accessories and auxiliaries.

E. I. du Pont de Nemours & Co. is expanding and modernizing its Newburgh, N. Y.,



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FOR THIS MANUFACTURER!

Chemi-Drain
CHANNEL PIPE

1. Channels Hot Sulphuric Dilute for Processing
2. Safely Drains Corrosive Waste Chemicals

Harkness & Cowing Division of Arnold-Hoffman & Co., Cincinnati, solved a dual acid channeling problem with Chemi-Drain. It carries hot sulphuric dilute to a tiled vat for a tallow reclaiming process, and intermittently, serves as a drain system for corrosive chemicals. Chemi-Drain is completely unaffected by acids or other corrosives. It is designed for flush-with-the-floor installations that can be covered by a grill or removable plate. *Write for a four-page bulletin with full details.*

LC-256-6

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Crushing and Shredding
FOR... PROCESSING and RECOVERY OPERATIONS

SODA ASH · PETROLEUM COKE · PITCH · ASPHALT
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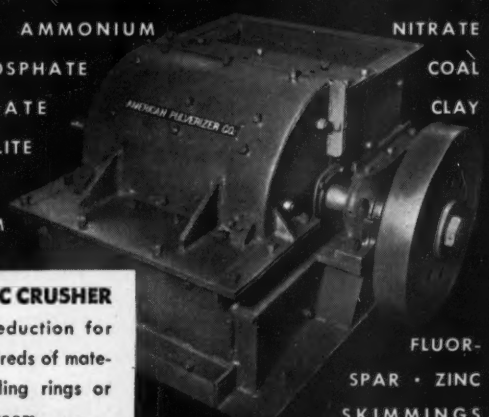
CARBIDE · CRYOLITE
GLASS CULLET
BAUXITE · GYPSUM



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Efficient, controlled reduction for scores of industries, hundreds of materials. Equipped with rolling rings or hammers. Minimum headroom.

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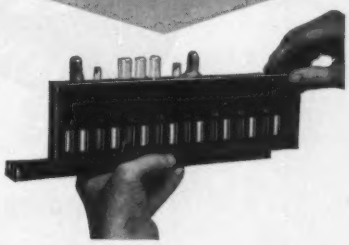
with
TAYLOR COMPARATORS
REDUCES WASTE



Helps determine EXACT amounts of chemicals needed for adjustments

Fast, accurate colorimetric analyses, with Taylor Comparators, make it easy to determine the *exact* amounts of chemicals needed to control many chemical processes. Colorimetric tests with Taylor Comparators may be made on the spot in only a few minutes. Simply fill the three test tubes with the solution to be tested, add reagent to center tube and move color standard slide across until colors match.

Taylor Comparators are durable, lightweight and portable; many serve for several determinations with only a change of color standard slides.

COLOR STANDARDS GUARANTEED

Taylor liquid color standards carry an unlimited guarantee against fading. There's no danger of mechanical inaccuracy. Each complete set of standards is mounted in a lightweight, durable plastic slide . . . no single standards to handle.

CALL YOUR LABORATORY SUPPLY HOUSE for Taylor sets, or write direct for FREE HANDBOOK, "Modern pH and Chlorine Control". Gives theory and application of pH control, illustrates and describes full Taylor line.

W. A. TAYLOR AND CO.
414 RODGERS FORGE RD. • BALTIMORE, MD.

Temperature Control Problem?

Call Partlow's nearby office for fast action

Atlanta, Ga., D. H. Gunselus, 3252 Peachtree Rd., N.E.
Birmingham, Ala., General Combustion Co., 652 Brown Marx Bldg.
Boston, Mass., F. R. Waugh, P.O. Box 47, Waltham, Mass.
Buffalo, N.Y., E. H. Seelbach, Box 56, Kenmore Sta.
Chicago, Ill., Finn & Conway, 8216 S. Western Ave.
Cincinnati, O., G. T. Desjardins, 515 Melish Ave.
Cleveland, O., Glatte & Co., 2012 West 25th St.
Dallas, Tex., C. A. Drum, 6331 Northwood Rd.
Davenport, Ia., Deco Engineering Products, 320 Western Ave.
Denver, Colo., Slaybaugh-Thompson Co., 100 W. 13th Ave.
Des Moines, Ia., Deco Engineering Products, 1112 Locust St.
Detroit, Mich., O. Stirling, Inc., 6432 Cass Ave.
Fargo, N.D., Dakota Elec. Supply Co., 1017 4th Ave., N.
Greensboro, N.C., J. L. Paradis, P.O. Box 5121
Indianapolis, Ind., Young-Streeter Co., 6220 College Ave.
Kansas City, Mo., Brandwine Equip. Co., 4638 Nichols Pkwy.
Los Angeles, Calif., Pacific Scientific Co., 1430 Grande Vista Ave.
Memphis, Tenn., C. J. Gaskell Co., Inc., 216 N. Lauderdale Ave.
Mexico, Southmost Equip., Inc., P.O. Box 1324, Brownsville, Tex.
Montreal, Can., Bescom Corp., Ltd., 1015 Atwater Ave.
New Haven, Conn., Etter Engineering Co., P.O. Box 1944
New Orleans, La., F. P. Fischer Eng. Co., 7924 Maple St.
New York, N.Y., A. M. Stock, Inc., 2891 Central Ave., Union City, N.J.
Omaha, Neb., Deco Engineering Products, 4305 N. 54th St.
Philadelphia, Pa., A. M. Stock, Inc., Rm. 206, 11 West Ave.
Pittsburgh, Pa., Woessner-McKnight Co., 115 S. Highland Ave.
Portland, Ore., Pacific Scientific Co., 1218 S.E. 7th Ave.
Providence, R.I., G. M. Brenckle, Jr., P.O. Box 94, Cranston, R.I.
St. Louis, Mo., Brandwine Equipment Co., 1709 Big Bend Blvd.
San Francisco, Calif., Pacific Scientific Co., 25 Stillman St.
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Export Office, Ad Auriema, Inc., 89 Broad St., N.Y. 4

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New Hartford, N.Y.

Send for Condensed Catalog of rugged mercury-actuated Partlow Temperature Controls for gas, liquid or solid process control in —30°F to 1200°F range.

FIRMS . . .

coated fabrics plant at a cost of $3 million.

American Potash & Chemical Corp. has set up district sales offices at San Francisco and at Portland, Ore.

Nuclear Corp. of America has acquired the Central Sales & Mfg. Corp. of Denville, N. J. The move increases Nuclear's overall manufacturing facilities by more than 50%.

Atomic Energy Commission has added ordnance engineering functions to its weapons development activities in Livermore, Calif.

Verde Valley Industries will complete a 2,500 bbl./day cement plant at Clarksdale, Ariz., by 1957.

Dorr-Oliver, Inc., has announced the organization of a new pulp and paper technical division.

Columbian Carbon Co. is building a $150,000 office-laboratory in Akron, Ohio.

Spencer Chemical Co. has purchased the assets of the Parker-Browne Co., Fort Worth, Tex., a producer of liquid carbon dioxide and dry ice.

Air Products, Inc. has received two government contracts, totaling $9.5 million, to build and operate two liquid oxygen generating units at Air Force sites near Sacramento and Los Angeles.

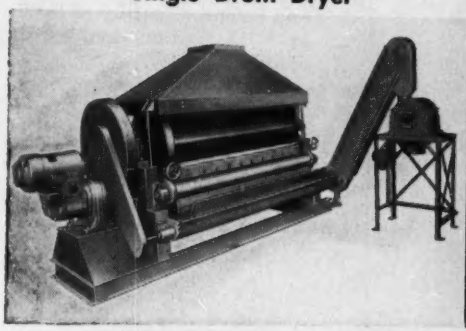
Crown Zellerbach Corp. has bought the Waxide Paper Co. which has waxed paper converting plants in St. Louis and Kansas City.

International Paper Co. has purchased $33 million worth of timberlands from Olin Mathieson Chemical Corp. in central Arkansas, western Louisiana, and eastern Texas.

Resistoflex Corp., manufacturer of special purpose hoses and plastics products for industry, has built a new plant

36" Diameter x 84" Long

DAVENPORT ATMOSPHERIC
Single Drum Dryer



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PRESSING—DRYING and COOLING Equipment

Continuous DeWatering Presses

ROTARY DRYERS
Steam Tube, Hot Air and Direct Fire

Atmospheric DRUM DRYERS

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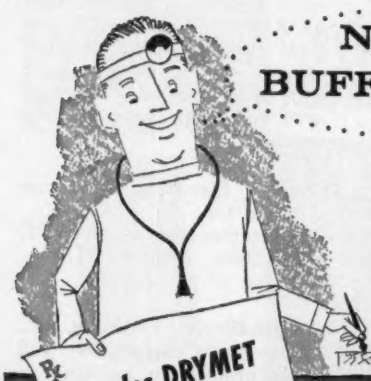
Water and Air

"DAVENPORT" ATMOSPHERIC (Single) DRUM DRYER

Permits the continuous drying of a great number of materials from slurry stage into dried products, at a low operating cost. The process of drying is accomplished by applying the liquid material in a thin film to the revolving steam heated moving drum. Dried material is removed by a blade and drops into a conveyor.

Let our engineers consult with you on your Pressing, Drying and Cooling problems or send for our catalog A. For quick reference consult your Chemical Engineering Catalog.

davenport MACHINE and FOUNDRY COMPANY
DAVENPORT, IOWA U. S. A.



NEED MORE BUFFER CAPACITY?

Take full advantage of the excellent buffer capacity built into Cowles DRYMET. You can reinforce the cleaning power and lengthen the useful life of your detergent formulations with Cowles DRYMET.

℞ Cowles DRYMET Anhydrous Sodium Metasilicate

SEND THIS COUPON—GET THIS

DRYMET File Folder of Technical Data—Formulations.

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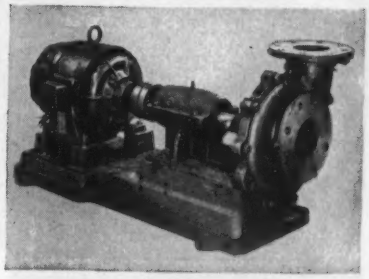
YOU CAN DEPEND ON *Frederick*



SSV PUMPS
for most efficient, carefree service!

CHECK THESE FEATURES

- Single stage, single end suction—with enclosed or open impeller.
- 1" to 4" discharge openings; heads up to 220 feet; operating speed—1750 rpm.
- One piece impellers, secured to shaft by key and lock nut, or threaded, give long service.
- Flanged suction and discharge openings mean easier connecting and disconnecting of joints.
- Vertically split pump casing and horizontally split bearing housing give maximum accessibility for maintenance.
- Extra large stuffing box, or mechanical seal—both provide minimum leakage.

Enclosed impeller types for chemicals, oils, juices, clear liquids, acids, etc. Open impeller types for slurries, brewery mash, food mash, white water, paper stock up to 2% consistency, etc. Constructed of metals to meet *your* requirements—cast iron, nickel, stainless steel, monel, etc. Send your requirements to our skilled staff for suggestions. Ask for free copy of Bulletin 107.

FREDERICK PUMPS

FREDERICK IRON AND STEEL, INC.
FREDERICK *Est. 1890* MARYLAND

HERE is the ideal CHECK VALVE for tanks and other vessels

When used with tanks (as shown here), dry cans, retorts and pressure vessels of all kinds, the DURABLA Check Valve Unit is the lowest cost, high-quality valve you can buy.

LOW COST—The cost is low because all you buy are the working parts. The vessel wall acts as the valve body.

HIGH QUALITY—Made of stainless steel (or a combination of stainless steel and Ni-resist), these valves will handle practically any liquid, gas or air—at all temperatures and pressures. They will operate in any position.

DURABLA Check Valves are available in seven standard line sizes, from ⅜" to 2". Ask your distributor for complete information or write us direct for bulletin CE-56 DM-13

DURABLA®

DURABLA MANUFACTURING COMPANY

114 Liberty Street, New York 6, N. Y.

FIRMS . . .

and research facility at Roseland, N. J., that doubles its former capacity.

Woodbury Chemical Co., St. Joseph, Mo., has bought Export Chemical Corp. of Denver, Colorado.

Olin Mathieson Chemical Corp. has bought a 40% interest in F. H. McGraw & Co., the engineering firm that's getting the job of building Olin's new $90-million aluminum plant near Wheeling, W. Va.

Socony Mobil Oil Co. will install a 22,000-bbl./day refining unit for improving the quality of heating oil and other distillate fuels at its Paulsboro, N. J., refinery. Completion is set for spring of 1957.

John E. Schulze and Son, division of Bell & Gossett, has completed an addition to tall oil and other fatty acids facilities at its Chicago plant.

Kaiser Gypsum Co. has started up a gypsum products plant at Antioch, Calif., with annual capacity of 94 million sq. ft. of board. A second unit to be completed this fall will boost the figure to 274 million.

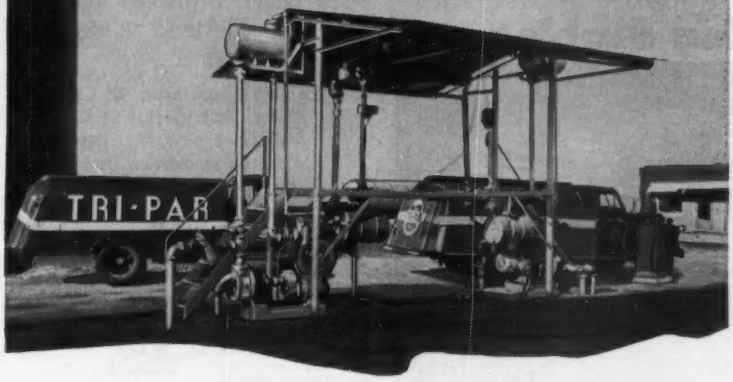
Duncan, Dieckman, Duncan Mining Co., St. Louis, Mo., has started up a new mill near Mena, Ark., for the upgrading of manganese.

Sylvania Electric Products, Inc., plans a new engineering and pilot production building in Towanda, Pa., for its tungsten and chemical division. It will be completed in the summer of 1957.

Continental Oil Co. has purchased Sherwood Refining Co., Englewood, N. J., manufacturer of industrial chemicals. Sherwood operated plants at Gretna, La., and Karns City, Pa.

Whiting Corp. Ltd., Canadian subsidiary of Whiting Corp., Harvey, Ill., has purchased Volta Mfg. Co., Ltd., Welland, Ont. Volta will handle manu-

FAST PUMPING WITH VIKINGS in EITHER *DIRECTION*



TRI-PAR OIL COMPANY, Saukville, Wisconsin, makes good use of Viking Pumps reversible feature. The pumping system has a single suction line and a single discharge line which can be operated in either direction, eliminating the piping manifold. Speeded to deliver 325 G.P.M., the pumps can unload transports to storage and load delivery trucks from storage by merely reversing action.

Pumping units have lost no time from their operation, during the three years they have been in service, and have handled approximately 25,000,000 gallons of gasoline and fuel oil in that period.

Perhaps Viking Pumps can speed your operation and simplify your pumping. Types and sizes for most industrial pumping. For information, write for Bulletin 565c.

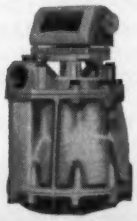
VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. In Canada, it's "*ROTO-KING*" pumps

See our catalog in Sweets

BOWSER

SYSTEMS SPEED LIQUIDS FROM RECEIPT TO DELIVERY

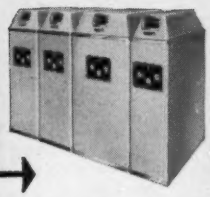


METERS & FILTERS

. . . . control inventory and quality from storage or tank car through plant with meter-printed tickets for accounting of liquids handled.

PROPORTIONERS & BLENDERS

. . . eliminate costly batching with closed system compounding of liquid components. Accuracy yields uniform, controlled product.



FILLERS & PACKAGERS

. . . automatically control delivery and packaging of plant, process or end-product liquids faster at lowest cost with Bowser systems.

WRITE FOR CATALOGS

BOWSER NATIONWIDE SALES AND SERVICE

BOWSER PROGRESSIVE PROCUREMENT PLAN

. . . all equipment available on lease or purchase payment program.

REGIONAL OFFICES: ATLANTA · BOSTON · CHICAGO · CLEVELAND · DALLAS · KANSAS CITY · LOS ANGELES · NEW YORK

BOWSER, INC., 1375 E. Creighton, Fort Wayne, Ind.

CUT YOUR VALVE MAINTENANCE!

with DOW CORNING VALVE SEAL

the nonmelting, chemical resistant SILICONE lubricant

Dow Corning Valve Seal retains its lubricating effectiveness at temperatures ranging from —40 to 500 F. It has excellent resistance to oxidation and a wide variety of chemicals and gases. With these properties, plus a high order of water repellency, Valve Seal increases valve life and efficiency; reduces maintenance costs; eliminates need for stocking a variety of special purpose valve lubricants; and facilitates more continuous processing.

Many uses for Valve Seal

Use Valve Seal wherever the life or efficiency of conventional lubricants are limited by extreme temperatures, corrosive chemicals, gases or steam. A few typical applications include: pressure lubricated plug valves; automatic control valves; flow meter bearings; ceramic plug cocks; pump packings; delicate equipment and recording instruments exposed to a wide range of temperatures.

TRY IT NOW!

DOW CORNING SILICONES

MAIL COUPON TODAY FOR **FREE SAMPLE**

Dow Corning Corporation
Midland, Mich., Dept. 2605

Please send me free sample of Dow Corning Valve Seal.

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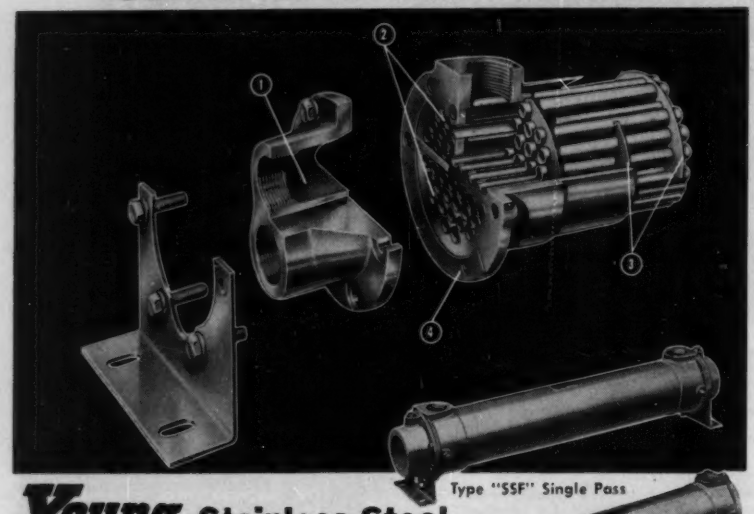
COMPANY_____

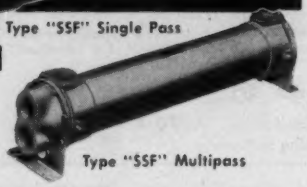
ADDRESS_____

CITY_____ ZONE____ STATE____

Young Engineering Talent
Solves Corrosion Problems



Type "SSF" Single Pass



Type "SSF" Multipass

Young Stainless Steel
heat exchangers provide more cooling surface per unit volume

The problem: Meet the Chemical Industry's need for corrosion-resistant heat exchangers.

How Young solved it

After months of testing, Young Radiator Company utilized a special type of stainless steel for fabricating heat exchangers. They are for use in the processing of highly corrosive chemical liquids and gases. The newer Young Exchangers are engineered to withstand expansion strains and have reserve capacity. They include factors for fouling, and simplified construction makes cleaning easy.

1 Smooth flow bonnet distributes fluid with minimum turbulence to tubes.

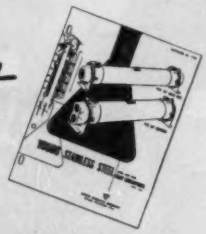
2 Tubes are brazed into headers.

3 Baffles made to close tolerance.

4 Gasket eliminates by-passing, fluid leakage.

Put Young Talent to work for you . . .

Solving heat transfer problems is what we do best because it is our very reason for being. You, too, can harness the power of Young engineering talent. Write, wire or call without obligation.



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Young RADIATOR COMPANY

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Creative HEAT TRANSFER ENGINEERS FOR INDUSTRY

Heat Transfer Products for Automotive, Aviation and Industrial Applications. Heating, Cooling, Air Conditioning Products for Home and Industry.

Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

FIRMS . . .

facture of its own and Whiting's line of products in Canada.

Kaiser Aluminum & Chemical Corp. will install $1.6 million worth of new facilities at its Chalmette works including a plant to reclaim cryolite.

Hart Products Corp., manufacturer of textile, leather and industrial chemicals, has opened a new research and development laboratory in Jersey City, N. J.

Sinclair Refining Co. plans a $1.3 - million hydrofinishing unit for its East Chicago, Ind., refinery.

Marquette Iron Mining Co., pointly owned by Inland Steel Co. and Cleveland-Cliffs Iron Co., will build and operate a low-grade iron ore beneficiation plant in the Marquette range of the Michigan upper peninsula.

Morton Salt Co. will build $4-million executive and general offices in Chicago.

American - Marietta Co. has bought the Presstite Engineering Co. of St. Louis.

MacMillan and Bloedel Ltd. has begun construction of a $2-million plywood sheathing mill at its Vancouver plywoods division project in British Columbia.

St. Regis Paper Co.'s Panelyte Div. as opened a thermoplastics laboratory at Richmond, Ind.

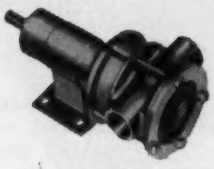
Hills-McCanna Co., Chicago, has bought land in the Village of Carpentersville, Ill., for expansion of manufacturing facilities for diaphragm valves and chemical metering and proportioning pumps.

Cook Research Laboratories, division of Cook Electric Co., Chicago, has established a service group devoted to computing and data reduction.

Monsanto Chemical Co.'s plas-

cut pumping costs with

JABSCO INDUSTRIAL PUMPS



Model 485
316 S.S. Construction—Sealed Ball Bearings —Mech. Shaft Seal

- INSTANTLY SELF-PRIMING
- SIMPLE, COMPACT, ONLY ONE MOVING PART
- DURABLE NEOPRENE IMPELLER
- SELF-LUBRICATED
- TROUBLE-FREE OPERATION

JABSCO PUMPS

HERE'S another Jabsco industrial pump — designed and built for chemical, pharmaceutical and other industrial applications. Ideal for transfer of various liquids and acids — sump drainage, coolant pumping, general transfer, pulp in solution, filtering, brines, plating solutions — even fluids containing foreign matter or particles, silt, crystals, and other gritty materials. Bronze, stainless steel or plastic construction is available to *solve your specific* pumping problems. Pumps either light or heavy viscous liquids. Temperature ranges from 35° to 180° F. Write for a Jabsco factory recommendation for your own needs. Specify application, fluid pumped, temperature, pressure, etc.

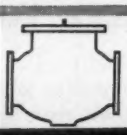
FREE — send for catalog sheets, detailed information... no obligation, of course!

PATENTED AND PATENTS PENDING

JABSCO PUMP COMPANY
2031 Lincoln Street, Burbank, California

YOU JUDGE THE BETTER BUY!

FOR A 6" VALVE INSTALLATION OPERATED AN AVERAGE OF 55 TIMES A DAY FOR 9 YEARS

Case History	GATE VALVE "A"	 G.A. FLOWTROL VALVE
REPAIRS	FREQUENT	NONE
REPLACEMENT	EVERY 3 MONTHS	NONE
ORIGINAL COST	$60.00	$360.00
APPROXIMATE TOTAL COST	over $2,000.00	$360.00

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Designers and Manufacturers of VALVES FOR AUTOMATION

Always SWIVEL and ROLL

DARNELL CASTERS AND WHEELS

Note these features:

RUBBER TREADS . . . a wide choice of treads suited to all types of floors, including Darnelloprene oil, water and chemical-resistant treads, make Darnell Casters and Wheels highly adapted to rough usage.

RUST-PROOFED . . . by zinc plating, Darnell Casters give longer, care-free life wherever water, steam and corroding chemicals are freely used.

LUBRICATION . . . all swivel and wheel bearings are factory packed with a high quality grease that "stands up" under attack by heat and water. Zerk fittings are provided for quick grease-gun lubrication.

STRING GUARDS . . . Even though string and ravelings may wind around the hub, these string guards insure easy rolling at all times.

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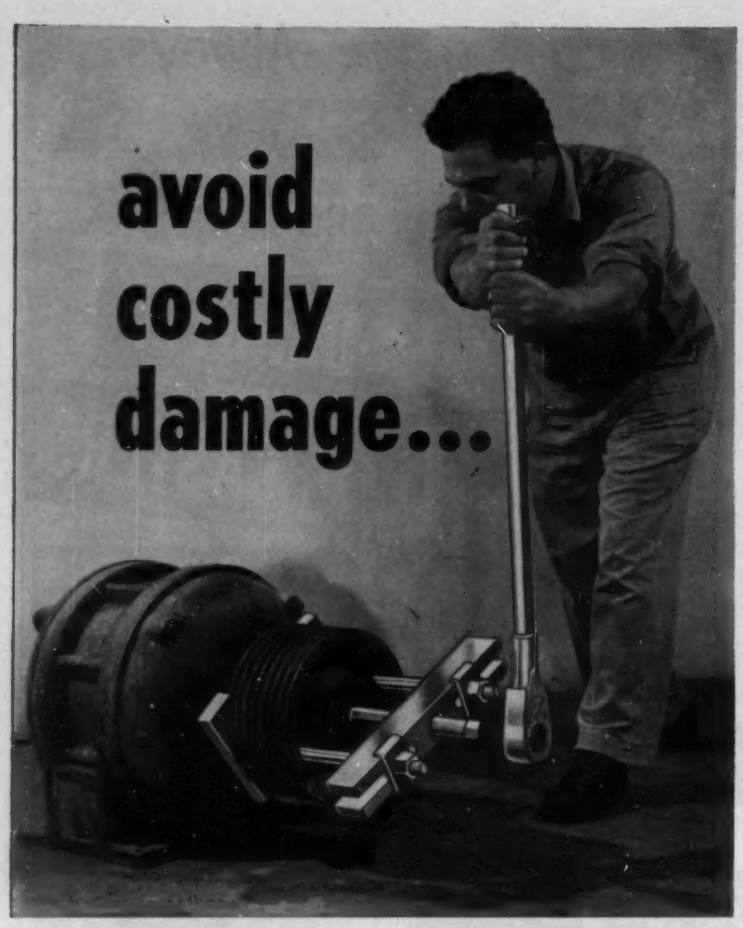

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Snap-on PULLER TOOLS

Snap-on pullers handle a wide range of pulling jobs safely, easily, quickly — protect expensive wheels, gears and other parts from damage — save hours of labor time. *Snap-on* builds a complete line of pullers with pulling pressures ranging from a few pounds to over 50 tons. You handle the toughest pulling jobs without the smashing sledge blows and shocks which can ruin expensive machinery.

Interchangeable parts, special adapters

Snap-on makes special adapters, reversible jaws and interchangeable parts that permit you to use one basic puller set for many jobs. Jaw-type pullers are designed to lock on to the job — eliminate slipping and binding.

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8106-E 28th Avenue • Kenosha, Wisconsin

FIRMS . . .

tics division is installing a model decorative and industrial laminating laboratory at Springfield, Mass.

Electric Reduction Co. of Canada Ltd. will build a multimillion plant in Hamilton, Ont., to process phosphorus for use in detergent, water conditioning and other industrial fields. Plants to produce sulfuric and wet-process phosphoric acids will also be installed.

Standard Oil Co. of California will spend $350 million for capital and exploratory purposes during 1956.

Celanese Corp. of America is building new offices, laboratories and pilot plants in Charlotte, N. C.

Vick Chemical Co. has acquired the National Drug Co., Philadelphia.

Allied Chemical & Dye Corp.'s Barrett Div. has acquired the Newark Plaster Co., manufacturer of gypsum wallboard, lath, sheathing and plaster.

Corning Glass Works has established a refractories division.

Bayonne Industries Inc. has purchased the Bayonne refinery of Tide Water Associated.

Diamond Alkali Co., Cleveland, has established two new autonomous units: the electro chemicals division; the soda products division.

Vitro Corp. of America has acquired Uranium Prospectors Co., Ltd., of Grand Junction, Colo.

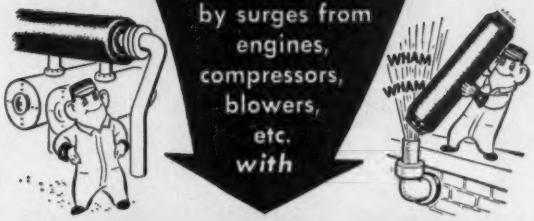
Minnesota Rubber and Gasket Co., Minneapolis, is building a $500,000 addition to its office, laboratory and plant facilities.

Imperial Paper and Color Corp., Glens Falls, N. Y., has bought a plant in St. Johns, Que., to manufacture a line of chemical pigment colors.

STOP

NOISE from air, steam and gases discharged to atmosphere

PULSATION in pipelines created by surges from engines, compressors, blowers, etc. *with*



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They are engineered to effectively correct your specific noise and pulsation problems. You will profit through better neighbor and employee relations and avoid compensation claims.

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Sound Engineering

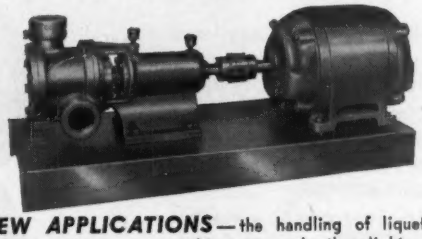
BURGESS-MANNING COMPANY

723 East Park Avenue, Libertyville, Illinois
Dallas, Texas

handle those *difficult jobs*

with

APCO Z4 *Process* PUMPS



NEW APPLICATIONS — the handling of liquefied petroleum gases, refrigerants and other light non-viscous liquids are easy for APCO Z4 Pumps.

SPECIAL METALS — APCO Z4 Pumps are obtainable in any machineable alloy. The small amount required of such metal represents a real economy.

PERFORMANCE FEATURES — of the APCO Pump are ideal for the type of process duties for which the APCO Z4 Pumps were designed.

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THE NEW YORK AIR BRAKE COMPANY

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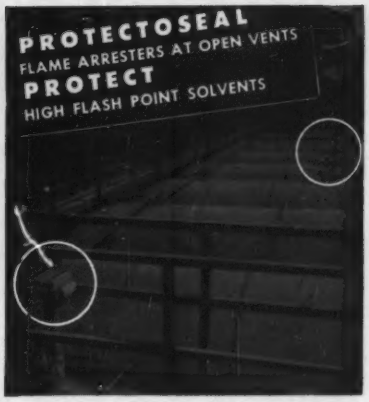
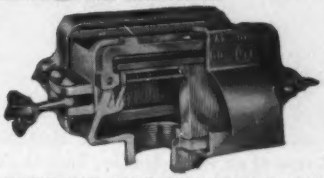


STORAGE TANK INSTALLATION AT EASTERN BY-PRODUCT BENZOL PLANT COMBINES

Maximum Air-Flow Capacities
Positive Fire Protection
Low-Cost Maintenance

Protectoseal Series No. 860 Non-Conservation Type Vents installed on the large, horizontal storage tanks of this By-Product Benzol Plant provide maximum air-flow consistent with operating efficiency, positive fire protection and effective, low-cost maintenance.



LIGHT WEIGHT, PRESSURE-TIGHT HOUSINGS
Combine ease of installation with durability. Housings meet hydrostatic pressure tests by Underwriters' Laboratories.

POSITIVE FIRE PROTECTION
Sturdy Protectoseal rectangular plate type flame arrester protects tank contents by preventing the propagation of fire and explosion into tank. Easily accessible for cleaning without disturbing original factory alignment.

LOW-COST MAINTENANCE
Modern swing-bolt design permits quick removal of vent covers and weatherhoods for visual inspection or cleaning.

VAPOR CONSERVATION TYPE VENTS

Similar in design to the Non-Conservation Vents but incorporate relief valves in the vent housing which conserve vapors to reduce costly evaporation losses. Valves retard intake of air and escape of vapors as tank normally breathes in and out.

IN-LINE VENTS

An exclusive Protectoseal design approved for installation at varying distances from open end of vent pipe. Suitable for inside tank house installations on storage or processing tanks, bleed lines, bleed tanks or other waste gas lines.

PROTECTOSEAL MANUFACTURES ALL TYPES OF FLAMMABLE LIQUID STORAGE TANK VENTING AND OPERATING EQUIPMENT.

SEE CHEMICAL ENGINEERING CATALOG, PAGE 1503

West Coast Warehouse: Los Angeles, Calif.
In Canada: Safety Supply Co., Toronto.

The Protectoseal Company,
1948 S. Western Ave., Chicago 8, Ill.

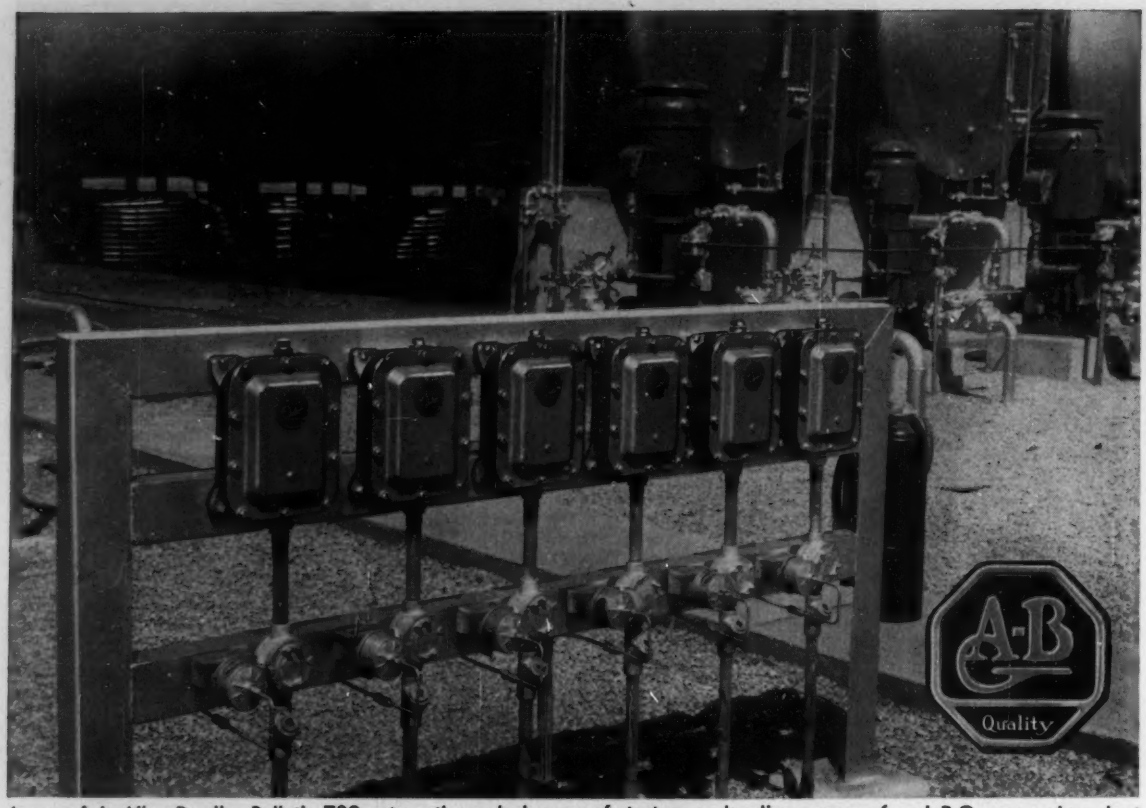
Please send me "Venting Fundamentals"

Name_____ Title_____

Company_____

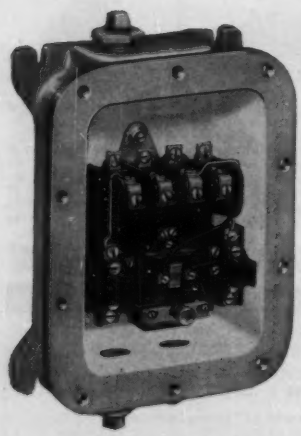
Address_____

City_____ Zone_____ State_____



A row of six Allen-Bradley Bulletin 709 automatic explosion-proof starters on loading pumps of an L.P.G. processing plant

FOR SAFE AUTOMATIC MOTOR OPERATION in Hazardous Locations *Specify* Allen-Bradley Explosion-proof Solenoid Starters



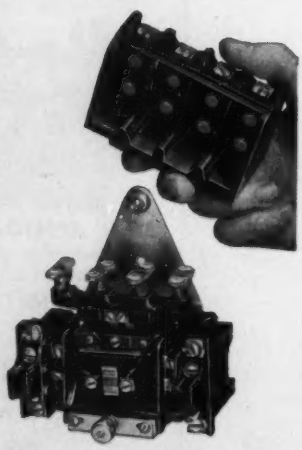
Bulletin 709 Solenoid Starter
Allen-Bradley Size 1 solenoid starter in a NEMA Type 7 enclosure for operation in hazardous gas locations. The cover and base have wide machined flanges.

It takes a lot of maintenance time to open and replace bolted covers of explosion-proof starters. That's why it is important to specify Allen-Bradley solenoid starters . . . which are good for millions of operations without contact maintenance. The thermal overload relays can be reset without opening the enclosure.

Reduce your plant maintenance by using Bulletin 709 solenoid starters. You can install them . . . and forget them. Write for the Allen-Bradley Handy Catalog . . . a valuable guide for selecting motor controls and enclosures for every type of industrial service.

Allen-Bradley Co.
1337 S. First St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL
QUALITY



Double Break, Silver Alloy Contacts
Arc hood lifted to show double break, silver alloy contacts on solenoid plunger and in arc hood. The basic solenoid design of all Bulletin 709 ratings is identical.

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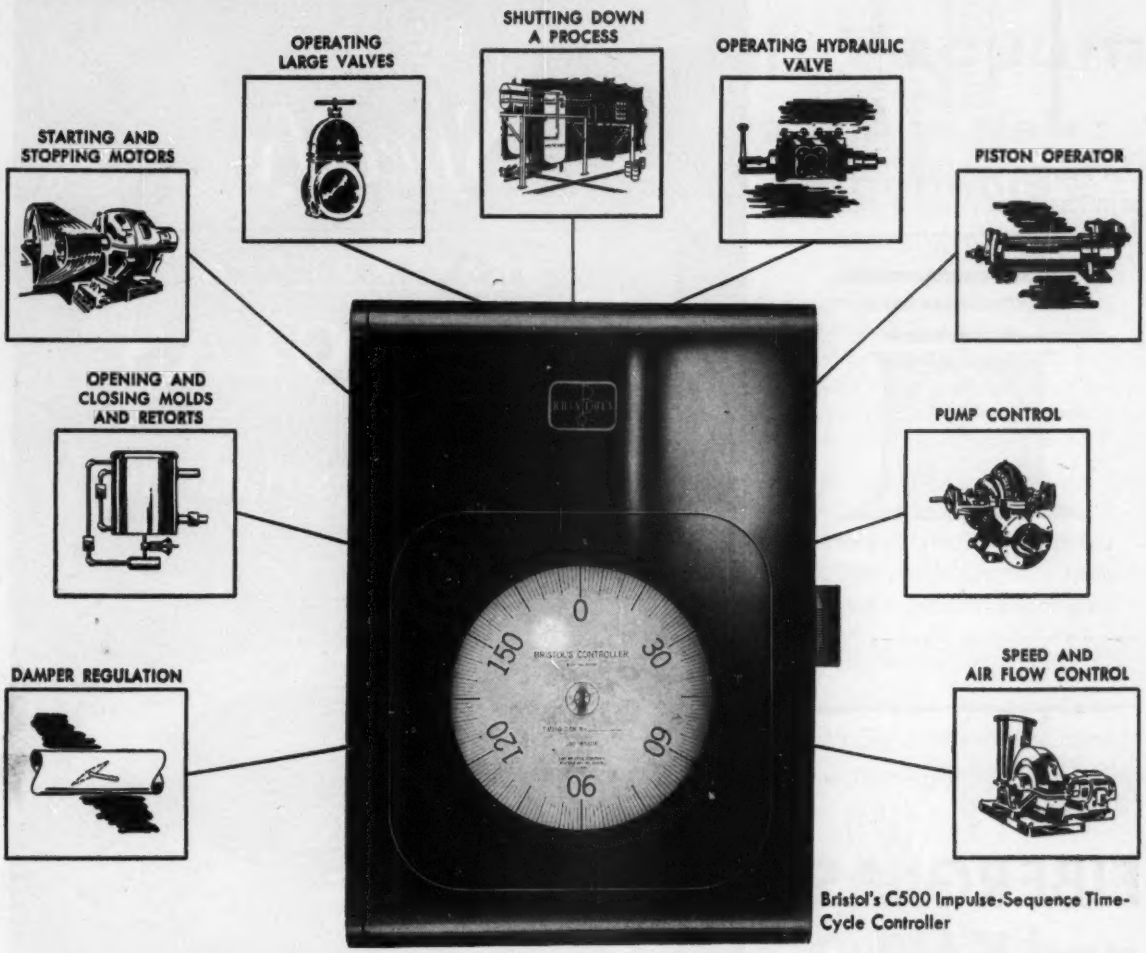

Bristol's C500 Impulse-Sequence Time-Cycle Controller

AUTOMATIC TIMING . . . THE KEY TO AUTOMATION

In almost every plant you'll see operations that *must* be carried out according to definitely timed sequences.

Experience has shown that such operations can be controlled with greater precision by automatic time-cycle controllers than by any other method—and when accurate timing is *continuously* maintained, here are the happy results:

- production from given installed equipment is increased
- uniformity of product is assured
- rejections are almost wholly eliminated
- operators are released for other important duties

Automatic control also puts the process under direct measurement—which means that operating conditions are more easily determinable and more easily reproduced.

Which controller should you select? Hundreds of leading industrial firms, many of them Bristol customers for over 66 years, are using Bristol Automatic Process-Timing Controllers. Our engineers have had long experience in the application of Automatic Process-Timing Controls in practically every industry. They're ready to work on your problem now. Write today for our Bulletin C305. The Bristol Company, 109 Bristol Road, Waterbury 20, Conn.

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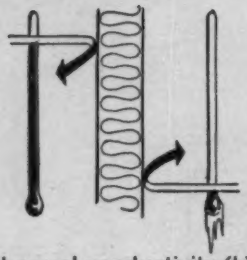
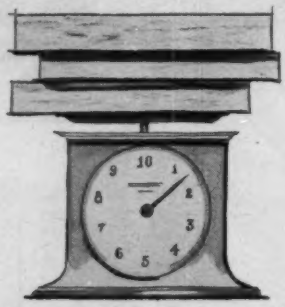
AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS



Low thermal conductivity (k) permits use of lesser thicknesses!



Lightweight Fiberglas blocks offer economical installation, easy maintenance!

Dimensionally stable, inorganic fibers of glass will never rot, corrode, settle!

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. . . distributed by approved Fiberglas distributor-contractors . . . offer the most versatile family of plant insulations available, in the widest range of shapes, sizes and thicknesses for every type of industrial application. With new *pink* Kaylo-*20* insulation serving the extra-high temperature ranges, you can now order—from *one* reliable supplier—complete insulation coverage *from lowest sub-zero to 1800°F.!* See *Sweet's Files, Chemical Engineering Catalog* or *The Refinery Catalog*. Or write: Owens-Corning Fiberglas Corporation, Dept. 97-E, Toledo 1, Ohio.

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*T-M. (Reg. U.S. Pat. Off.) Owens-Corning Fiberglas Corporation
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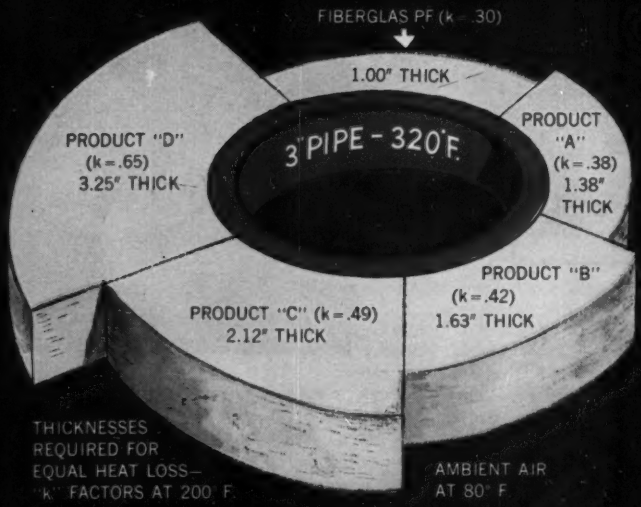
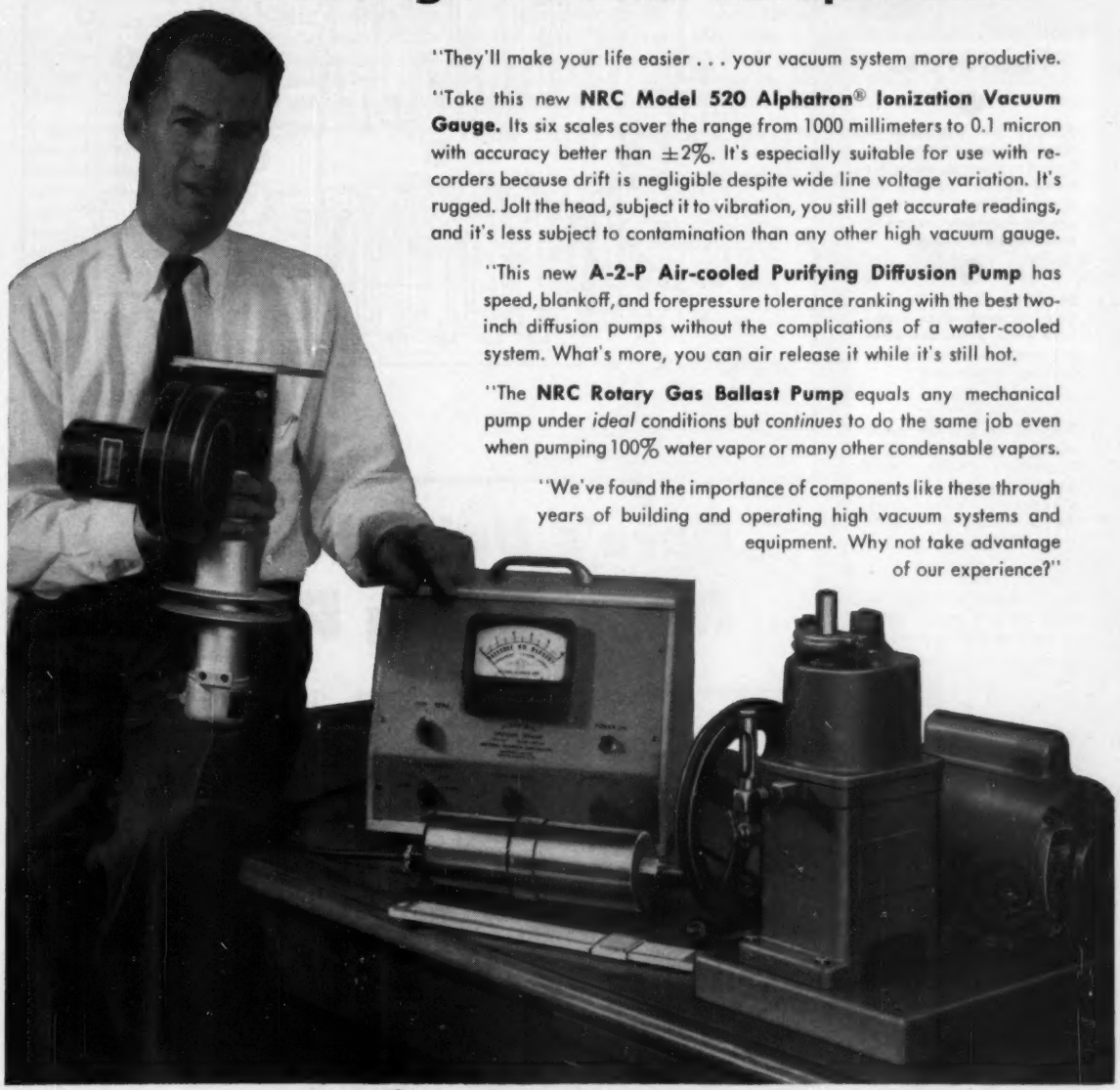
Industrial Insulations


FIBERGLAS PF (k = .30)
1.00" THICK
3" PIPE - 320°F.
PRODUCT "D" (k = .65) 3.25" THICK
PRODUCT "A" (k = .38) 1.38" THICK
PRODUCT "B" (k = .42) 1.63" THICK
PRODUCT "C" (k = .49) 2.12" THICK
THICKNESSES REQUIRED FOR EQUAL HEAT LOSS— "k" FACTORS AT 200° F.
AMBIENT AIR AT 80° F

for insulating efficiency!

"If You've Used High Vacuum

You'll Really Appreciate These New NRC High Vacuum Components"



"They'll make your life easier . . . your vacuum system more productive.

"Take this new **NRC Model 520 Alphatron® Ionization Vacuum Gauge.** Its six scales cover the range from 1000 millimeters to 0.1 micron with accuracy better than ±2%. It's especially suitable for use with recorders because drift is negligible despite wide line voltage variation. It's rugged. Jolt the head, subject it to vibration, you still get accurate readings, and it's less subject to contamination than any other high vacuum gauge.

"This new **A-2-P Air-cooled Purifying Diffusion Pump** has speed, blankoff, and forepressure tolerance ranking with the best two-inch diffusion pumps without the complications of a water-cooled system. What's more, you can air release it while it's still hot.

"The **NRC Rotary Gas Ballast Pump** equals any mechanical pump under *ideal* conditions but *continues* to do the same job even when pumping 100% water vapor or many other condensable vapors.

"We've found the importance of components like these through years of building and operating high vacuum systems and equipment. Why not take advantage of our experience?"

Other NRC high vacuum products include: analyzers, dehydrators, freeze driers, impregnators, gauges, metallizers, pumps, valves.

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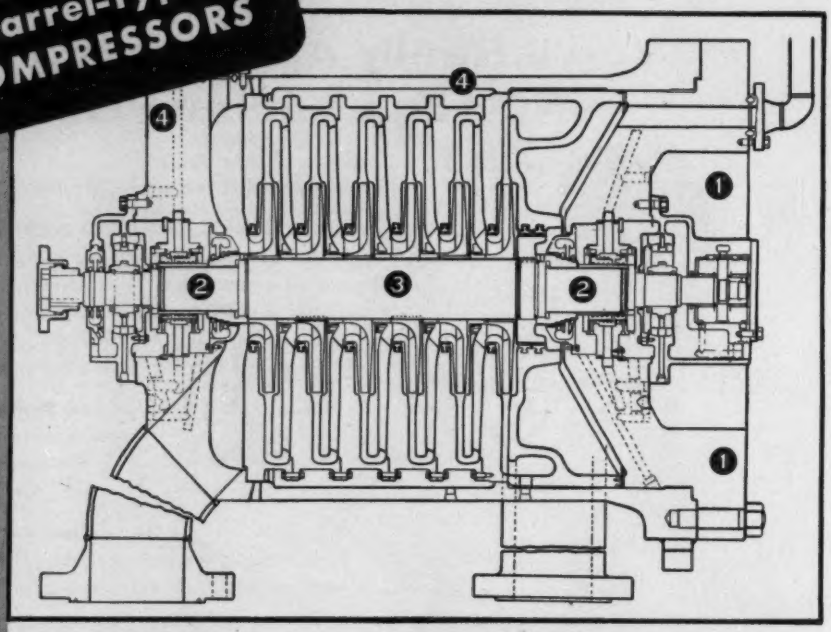
ALLIS-CHALMERS
High Pressure Barrel-Type COMPRESSORS



Features:

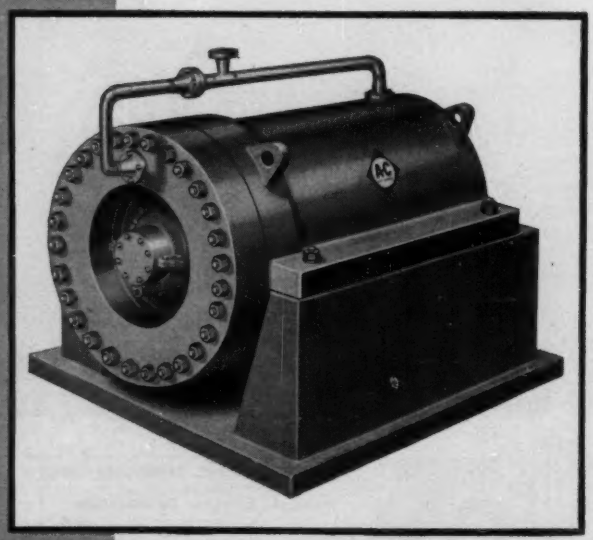
❶ **Simple to Maintain — Only one head bolted on. Spiral-wound metallic head gasket can be installed without cement or grease—quickly removed and reused if needed.**

❷ **Shaft Sealing — Double bushing seals with separate high pressure seal oil system. Inward seal leakage minimized.**

❸ **Rugged Rotor—For years of high speed operation. Impellers shrunk and keyed to shaft. Rugged riveted impellers with rivets milled integrally from blade edge.**

❹ **Extra Strong — Vertically split forged steel casing — safe at high pressures.**

Here's Unit Chosen for Reforming Process



This compressor is typical of Allis-Chalmers high pressure barrel units for "upgrading" processes.

Above are a few of the features that make it easy for maintenance men to keep equipment on stream around the calendar. Details of this design are yours for the asking. Call your nearby A-C office or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.

A-4967

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Snap•On is a flexible, resilient, one-piece pipe insulation molded of fine glass fibers that actually snaps on the pipe. Made in sizes up to 33" I. P. S. and in sections 6 feet long, **Snap•On** cuts the cost of insulating big pipe to a minimum. Once on the pipe, **Snap•On's** flexibility prevents cracking under thermal contraction and expansion.

Snug fit and easy application are by no means the only reasons why you'll want to use **Snap•On** for both hot and cold piping. Thermally, it is superior to any other pipe insulation on the market. It's clean and dustfree. It's attractive, easy to finish. And **Snap•On** is as permanent as a pipe insulation can be, yet can easily be removed and reused. If you can't say as much for your present pipe insulation—

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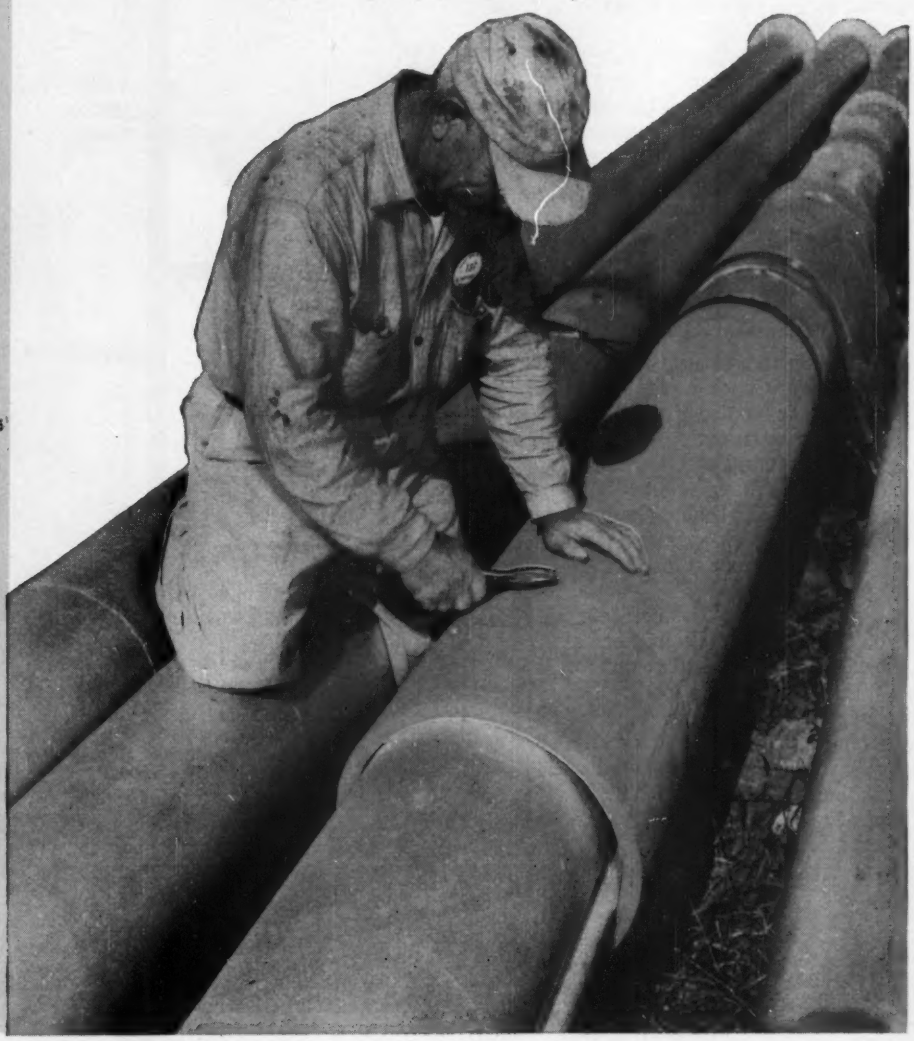

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AO's complete, "Strength Without Bulk" Line of NEOPRENE "PROTECTOCOTE" Clothing!

NOW . . . in the big AO Neoprene-Latex line you'll find 2 basic coats, 2 suit jackets, 3 pants, one-piece suit, hat, hood, police raincoats, utility rain suit, sleeve, spat, hip legging, regular and split leg aprons — and a utility bag and neoprene blankets and curtains. There's protection and fine fit for every worker exposed to abrasion, acids, alkalis, greases, oils, salt water, caustics or foul weather.

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In addition to a saturation coating, there's a back coating, and several face coatings (two applied after garments are sewn). A new compound and new application technique has added 25% to the tear strength and chemical resistance of each garment. And abrasion resistance steps up 30% to 40%.

Remember AO "Protectocote" won't peel or crack in normal work use . . . it's lightweight for comfort, contains no loaders . . . it won't stick in hot weather or become stiff in cold . . . it's easily, safely dry cleaned, laundered or scrubbed without injury. And it's work-styled to fit correctly. Ask your nearest AO Safety Products Representative, or write for new brochure.

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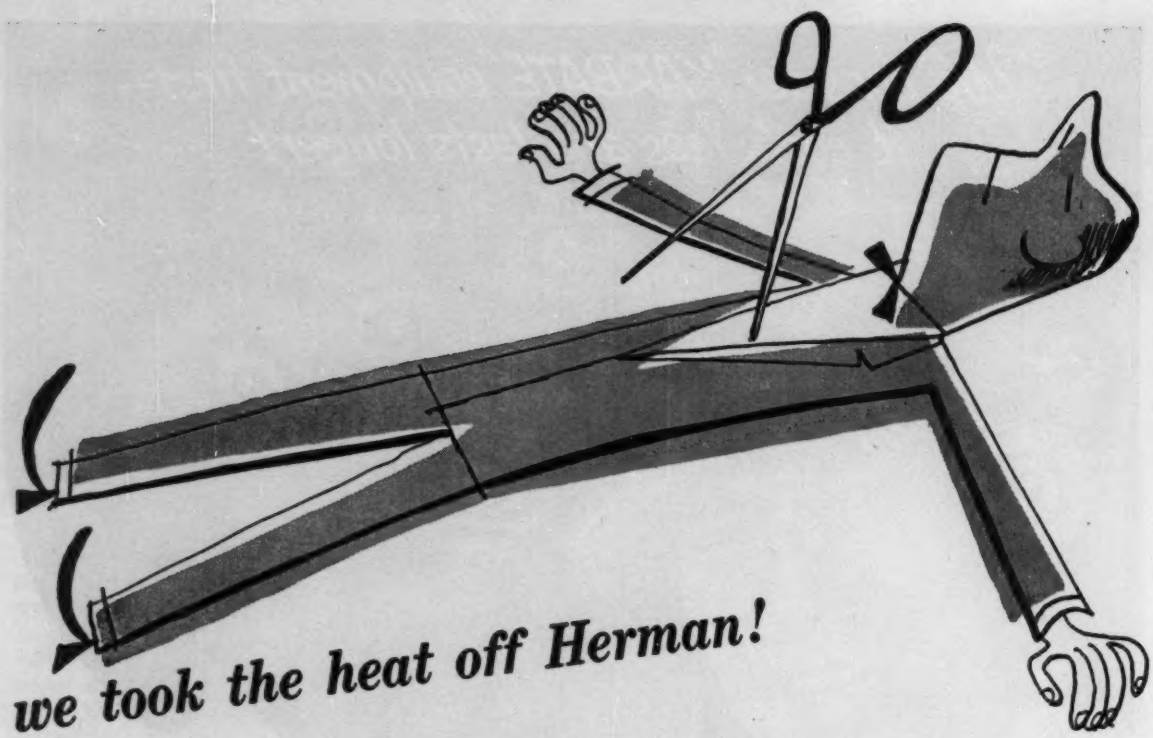

we took the heat off Herman!

Saved him from a horrible end, he says. From what Herman, a refinery supervisor down Houston way tells us, CE's *Inventory Issue* kiboshed a CPI tragedy right in his own home.

Seems his wife was pretty proud of her sewing. So was Herman – always talking it up at the plant about how much dough she saved on clothes. Only trouble was, she just had one pair of scissors, and Herman was forever borrowing 'em to cut out reading material from CHEMICAL ENGINEERING.

The day the *Inventory Issue* arrived though, he knew his snippers-snitchin' days were over. Saw right away how it wrapped up 12-months' key developments and eliminated his clip-and-file system in one fell swoop. New technologies, new plants, new chemicals and equipment, that wonderfully convenient Reader Service . . . *the works!* He was in ecstasy.

Couldn't understand when he told his wife about it though. She just up and fainted. Later, he keeled over himself when he found out she'd planned a scissorcide the next time he grabbed her shears.

But all's well now. A little vacation did the trick for mama. Today there's no happier CPI couple east of the Pecos. No snips around the house though – the little lady's clothes are all store-bought. And the only bragging Herman does at the plant is about *how much time he saves* . . . with the *Annual Inventory Issue of* CHEMICAL ENGINEERING.

ANNUAL INVENTORY ISSUE

Chemical Engineering

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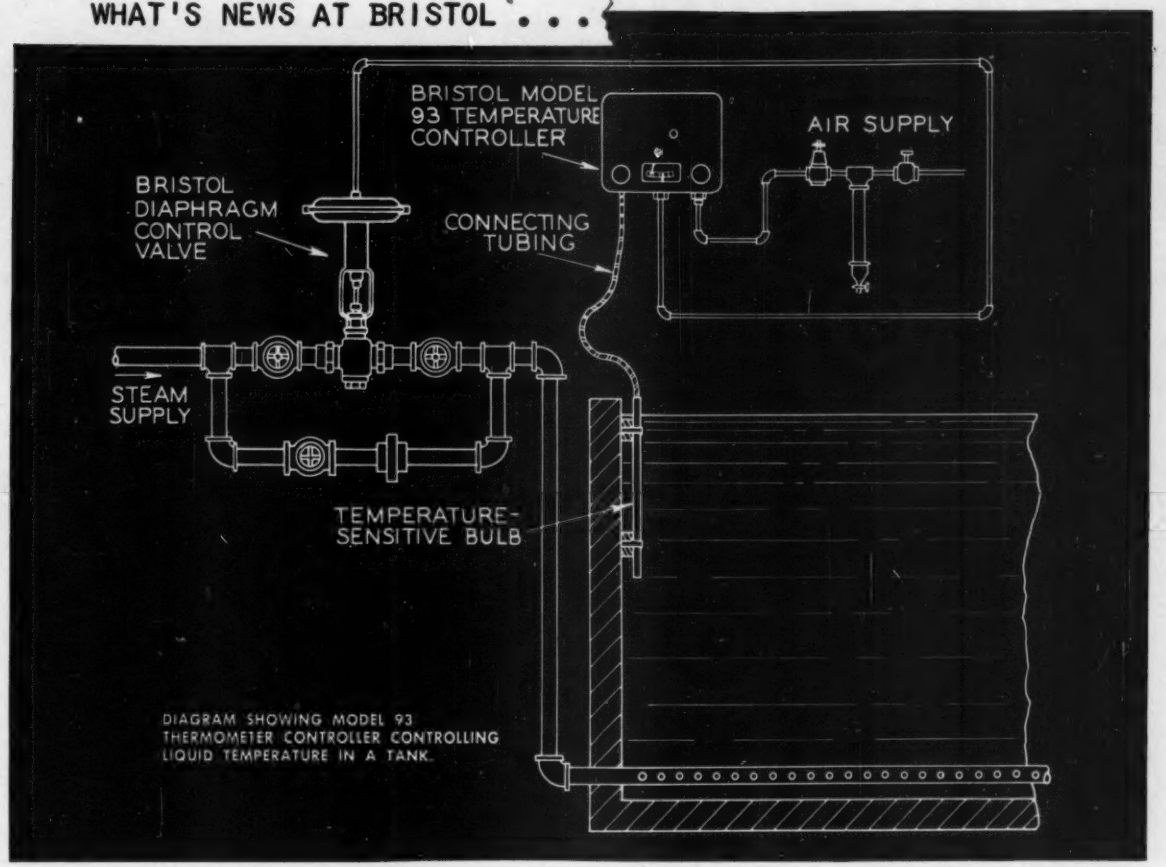
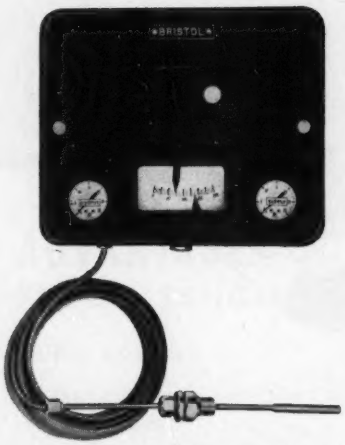


DIAGRAM SHOWING MODEL 93 THERMOMETER CONTROLLER CONTROLLING LIQUID TEMPERATURE IN A TANK.



MODEL 93 Thermometer Controller. Temperature Controllers are available in a variety of ranges, both Centigrade and Fahrenheit.

Where variables must be controlled but not necessarily recorded

If you have a control application where chart records are unnecessary or already provided for, then Bristol's Model 93 Free-Vane Air-Operated Controller is the instrument for you.

This small, compact instrument features the same precision measuring element used in all Bristol recording and controlling instruments, and the same high-sensitivity, frictionless Free-Vane control system used in all Bristol air-operated controllers.

Set-point adjustable to any value in the instrument range simply by turning pointer to desired value. Throttling range adjustable from ½% to 12% by the user.

Model 93 Controllers are offered for:

1. **Temperature** – from −125F to +1000F.
2. **Pressure** – from 0 to 10,000 psi.
3. **Liquid level** – in open or closed vessels.
4. **Flow** – of steam, gas, air or other liquids through pipes.

The Model 93 Air-Operated Controllers are described in complete detail in bulletin A115. Write for a free copy today. Also ask for our control valve catalogs. The Bristol Company, 109 Bristol Road, Waterbury 20, Conn. 5.25

TRADE MARK BRISTOL'S REG. U.S. PAT. OFFICE

BRISTOL

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In the chemical processing industries, CO_2 is a real "trouper" which can be made to perform in imaginative and diverse ways. As a *refrigerant* it is unsurpassed. It's dependable, non-mechanical, "cold," with a wide temperature range. As an *active ingredient* it is indispensable for carbonation, PH control and foaming of rubber and plastic materials. And, as an *inert atmosphere,* it is widely employed in the paint, pharmaceutical, packaging and chemical processing fields. These few examples just hint at the many applications for CO_2. We will be glad to discuss the possibilities of this versatile product for your particular processing method. Our wide experience in applying CO_2 to industrial problems is at your disposal.

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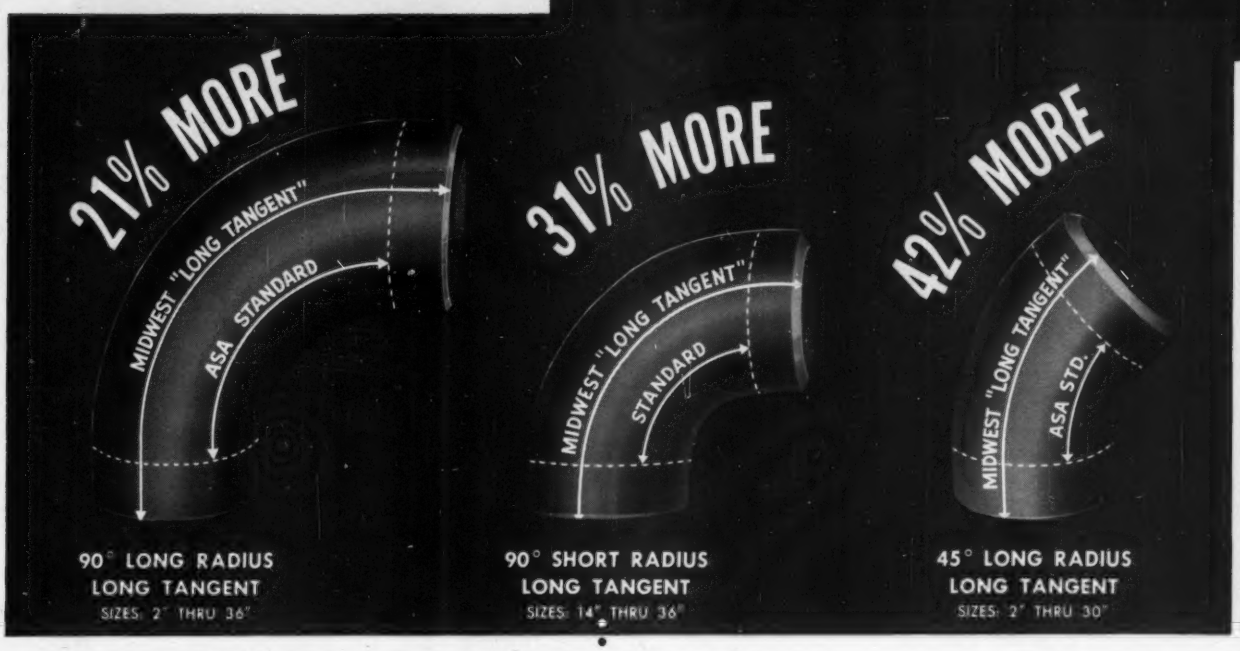
. . . you get 21% to 42% MORE ELBOW for the same cost

When You Use MIDWEST "LONG TANGENT" ELBOWS



90° LONG RADIUS LONG TANGENT
SIZES: 2" THRU 36"

90° SHORT RADIUS LONG TANGENT
SIZES: 14" THRU 36"

45° LONG RADIUS LONG TANGENT
SIZES: 2" THRU 30"

ADVANTAGES OF MIDWEST "LONG TANGENT" ELBOWS

- ★ They save pipe.
- ★ They often eliminate short nipples and their extra welds.
- ★ They save time and money in lining up and clamping pipe and fitting.
- ★ They make it easier to apply slip-on flanges.
- ★ They remove the circumferential weld from point of maximum stress and can be sleeved.
- ★ THEY COST NO MORE THAN OTHER ELBOWS.

The long tangents available *only* on Midwest Welding Elbows give you *more fitting for the same price* . . . Midwest "Long Tangent" Elbows cost no more than other elbows. This added length has numerous advantages for the user of welded piping . . . advantages that save money and improve piping. For all the facts, ask the nearest Midwest distributor or write us for Catalog 54.

MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo.
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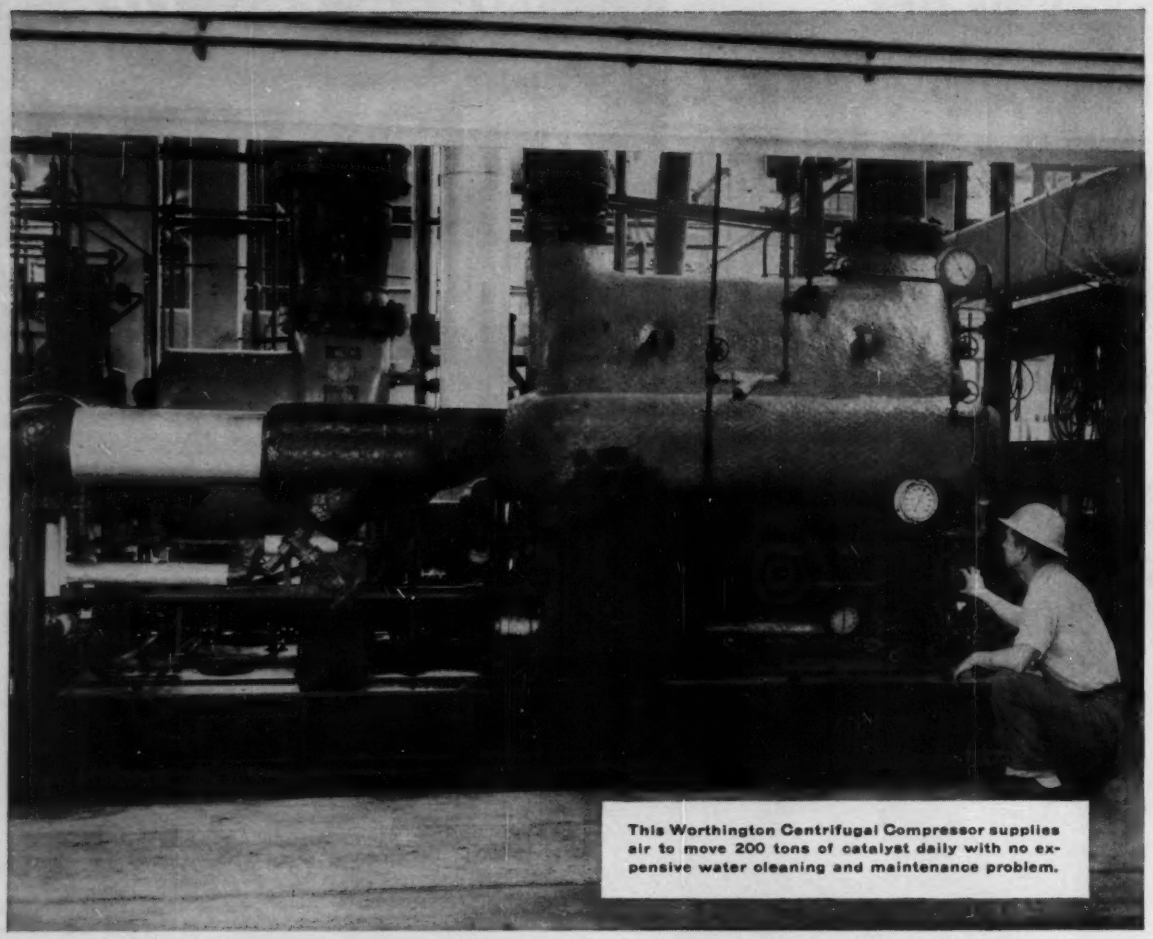

This Worthington Centrifugal Compressor supplies air to move 200 tons of catalyst daily with no expensive water cleaning and maintenance problem.

Process compression without diaphragm and water supply problems

Perhaps your processing can be compared to this operation at Cities Service Refining, where heavy gas oils are catalytically cracked into fuel gas, propylene, and butylene for alkylate and butadiene production, high octane gasolines, and light fuel oils. Here's an example of low-cost, high-volume processing, with a Worthington GUR centrifugal unit compressing the air to move 200 tons of catalyst per day in a trouble-free, economical manner. The costly diaphragm and exchanger maintenance problem inherent in the operation of an ordinary compressor is unknown with the Worthington GUR. At Cities Service's Lake Charles refinery, the Worthington centrifugal operates with 95° F. air at 100% relative humidity and 14.5 psia suction pressure, and discharges at 61 psia, 450° F., with a capacity of 4,875 CFM. The compressed air is used to transfer and aerate the catalyst. The temperature of the compressed air is controlled by means of interstage liquid injection . . . an exclusive development that effectively reduces the heat of compression without employing external heat exchangers. It is powered by a dependable Worthington steam turbine. Cities Service reports, "Governing and control are excellent, and in all other respects it is very satisfactory." If you'd like the same satisfaction for your process compression or refrigeration, why not get in touch with Worthington? Write your Worthington District Office or Worthington Corporation, Air Conditioning and Refrigeration Division, Section A6101, Harrison, New Jersey. A-6101

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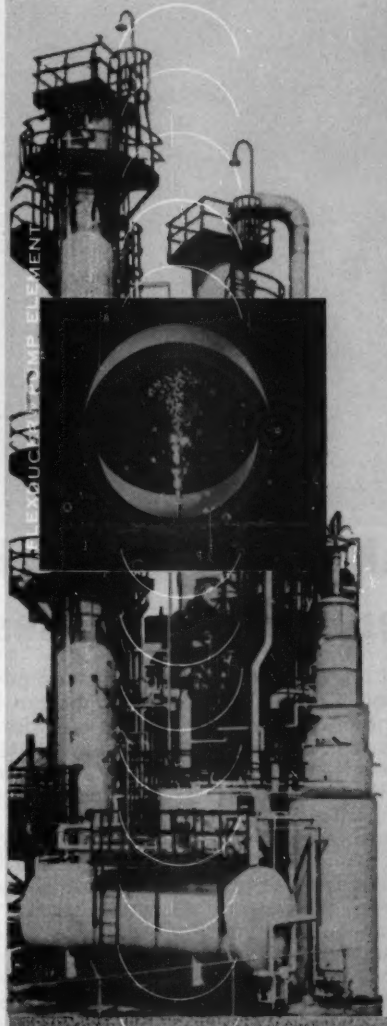
and THE PUMP WITH NO MOVING PARTS

. . . Important Contributions To Chemistry

Vibro-Ceramics offers a variety of advanced-design ultrasonic units for the chemical and allied industries. These new-type units — which operate over a frequency range of 30 CPS to 100 MC — substantially improve product quality and increase production . . . for example: the FLEXDUCER®, a revolutionary, new pump without moving parts, needs no priming, prevents contamination, eliminates leakage and can operate from a normal 60 cycle power source.

For many years ultrasonics' high-productive capabilities remained untapped . . . but now these inaudible sound waves can be generated and precision controlled by perfected Vibro-Ceramics' equipment . . . they improve mixing, emulsifying, degassing, cleaning, plating, flow monitoring and a variety of other manufacturing techniques. The application of ultrasonics makes heating, mechanical agitation and pressurizing by external forces unnecessary.



silent sound

To enable all manufacturers to benefit, Vibro-Ceramics has broadened the scope of its industry services:

• CONSULTATION

A competent engineering staff analyzes your requirements . . . makes specific recommendations.

• COMPONENTS

Once your needs are completely defined, Vibro-Ceramics can supply the necessary ultrasonic components — custom-tailored to fit your present machinery.

• SYSTEMS

Should an entire system be indicated . . . Vibro-Ceramics has the facilities and talents to create, build and install the required equipment . . . to sell or lease.

This versatile and powerful new energy — ultrasonics — can aid you too! Write to Dept. 802 for your copy of "Putting Ultrasonics to Work".

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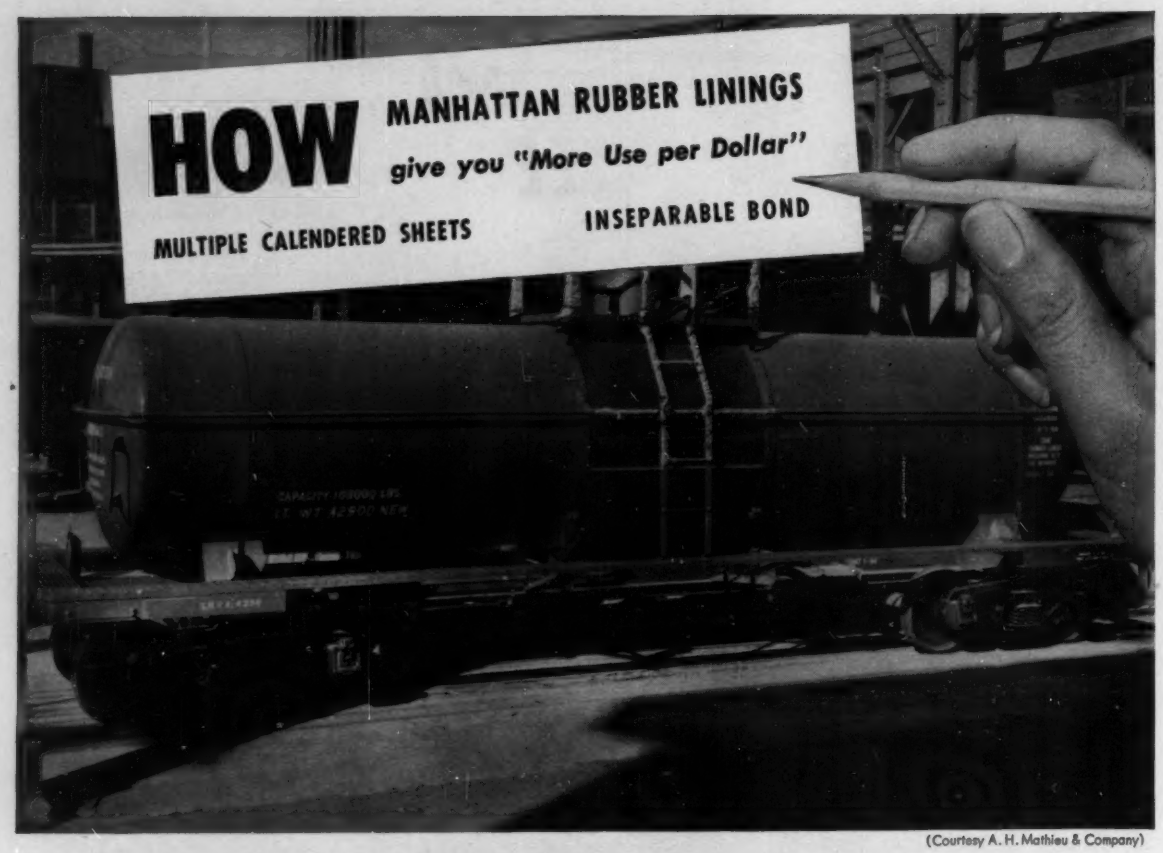

(Courtesy A. H. Mathieu & Company)

MANHATTAN Acid-Proof Rubber Linings Protect Equipment and Processes... Permanently

Corrosive acids, salt solutions and other chemicals require the kind of permanent protection possible with specially compounded, acid-proof Manhattan Rubber Linings. They are made from thick, multiple calendered sheets of natural or synthetic rubber that expand and contract with the metal under temperature changes. They won't harden, crack or break under normal conditions of use. An exclusive Manhattan process bonds the rubber lining to the metal so securely that actual tests have proved they can't be separated! This gives you *real, positive* protection against corrosion and abrasion of your equipment, and against contamination of your process solutions. Resistance to most acids, caustics and alkalis is as fool-proof as the most advanced lining compounds and methods can provide.

Manhattan has the most modern and complete lining facilities available today *plus* experience dating back to the first tank lined in this country. You can depend on Manhattan Rubber Linings to provide flawless, permanent protection. To make certain, every Manhattan Lined Tank is tested under high voltage to detect any possible imperfection before it is shipped to your plant. Equipment too large to be shipped can be custom-lined and vulcanized in the field by Manhattan specialists. Additional data about Manhattan Rubber Linings will be found in Manhattan's new Tank Lining Catalog #7115. Write for a copy today . . . or contact the R/M representative nearest you.

RM622

RUBBER LINING PLANTS AT PASSAIC, N. J. and NORTH CHARLESTON, S. C.

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USE *WELL-ENGINEERED* YARWAYS

■ Use pipeline strainers in your plant? If so, you've plenty of reasons for using YARWAY Fine Screen Strainers.

Some of the reasons are these:

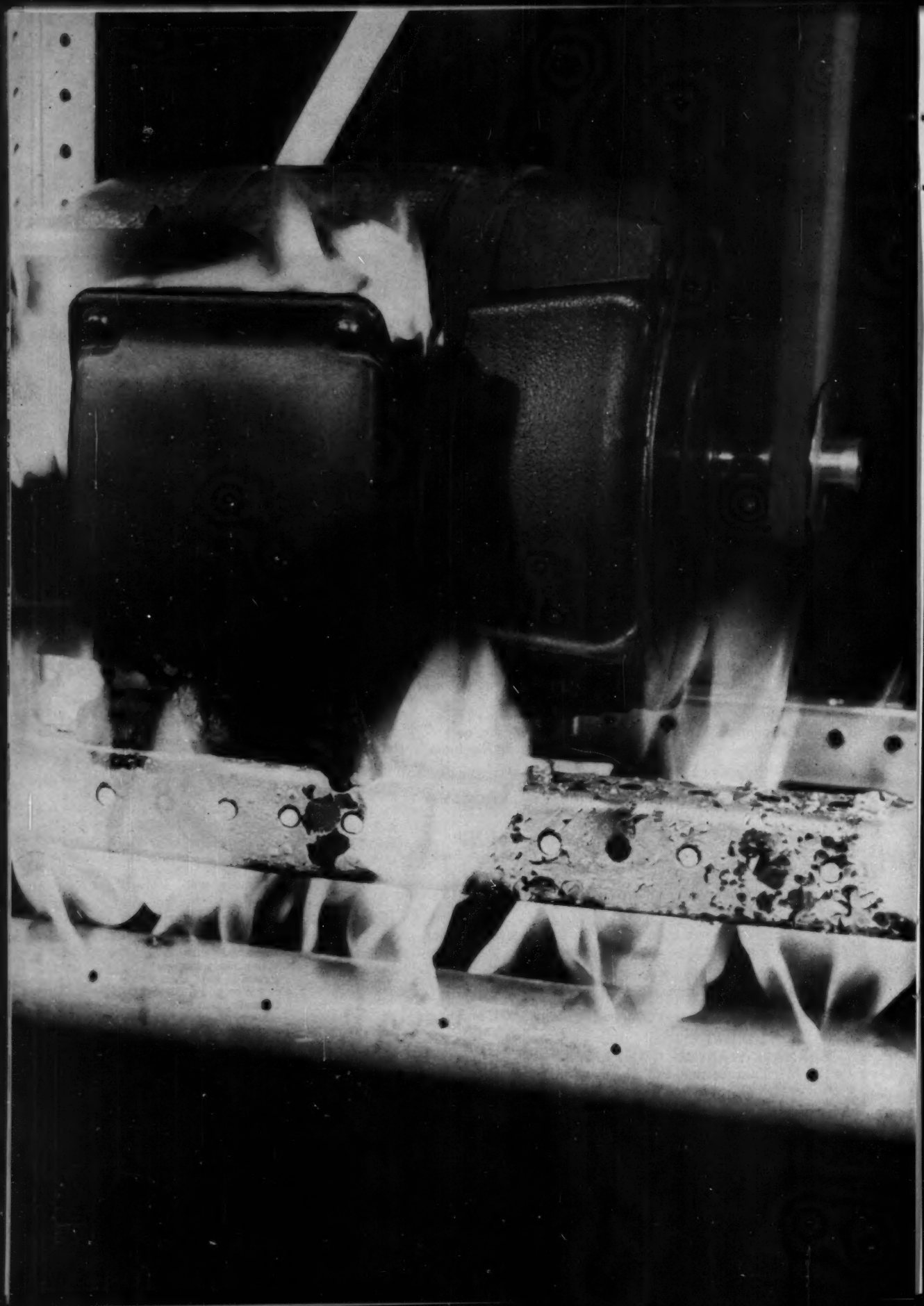
- Available in *iron* or *steel* with rust-resistant finish, also *bronze, stainless steel* and *aluminum.*
- Dutch weave Monel woven wire screens have high mechanical strength, extra fine straining service. Also perforated bronze, monel or stainless steel.
- Easy to remove screen caps with straight threads to assure proper alignment of screen.
- 10 standard sizes from ¼" to 3". Larger sizes to order. Also flanged and socket-weld connections.
- Stocked and sold by over 300 industrial distributors in the United States, Canada and abroad.

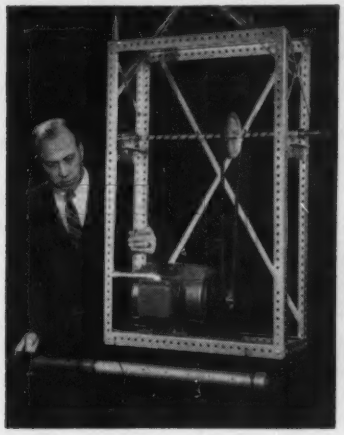
Write today for YARWAY Strainer Bulletin S-204, and name of nearest distributor.

YARNALL-WARING COMPANY
137 Mermaid Avenue, Philadelphia 18, Pa.

SCREEN EASILY REMOVED
Unscrew cap and screen comes out with it. When replacing, put screen in cap, then screw cap into body. Straight threads assure correct alignment, no screen distortion. Cap is tapped for pipe plug or blow-off line.

YARWAY FINE SCREEN STRAINERS





TOMORROW:

A standard motor that can survive infinite heat

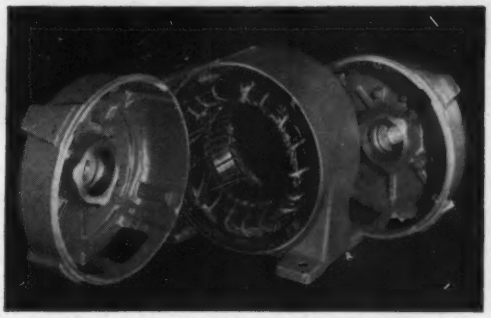
The new Life-Line A is another step closer

Westinghouse is working on tomorrow's motor today. Investigating new materials—testing existing motor designs.

No standard motor today can survive the ultimate test shown here. But we do know that the new Life-Line® "A" can operate under higher temperatures than ever before. It has stronger insulation and better bearing protection than any other motor on the market. It's industry's closest approach to a standard motor that is absolutely heatproof.

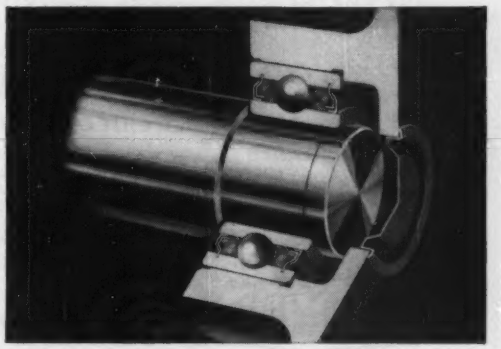
Your Westinghouse sales engineer can show you many additional reasons why the Life-Line "A" is industry's most advanced and preferred motor. Call him today.

J-21926



New fortified insulation includes exclusive Bondar, Bondite and Mylar*—three good reasons why the Life-Line "A" is so resistant to heat or any other motor contamination.

*DuPont Registered Trade-Mark



Two outer seals of new 4-way sealed bearing act as flingers and literally throw off damaging contaminations. Inner seals, attached to outer bearing race, are stationary and form a positive labyrinth.

WATCH WESTINGHOUSE!

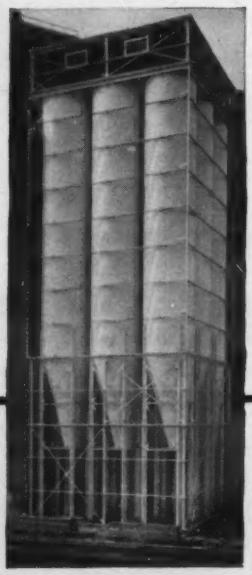
WHERE BIG THINGS ARE HAPPENING TODAY!

is stored in GRAVER-built bins!

On the right are pictured nine cereal and flour bins built for General Mills' newly expanded packaged foods plant on the Buffalo River. These were shop-fabricated by Graver to add important new capacity at this location.

Graver is skilled at building bins and industrial silos to precise specifications. Unusual sizes, special metals, intricate designs—all these are grist to Graver's know-how and years of experienced, specialized fabrication.

To solve your storage problems, consult Graver—a recognized fabricator for industrial storage.



GRAVER TANK & MFG. CO., INC.

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CHICAGO • NEW YORK • PHILADELPHIA • EDGE MOOR, DEL.
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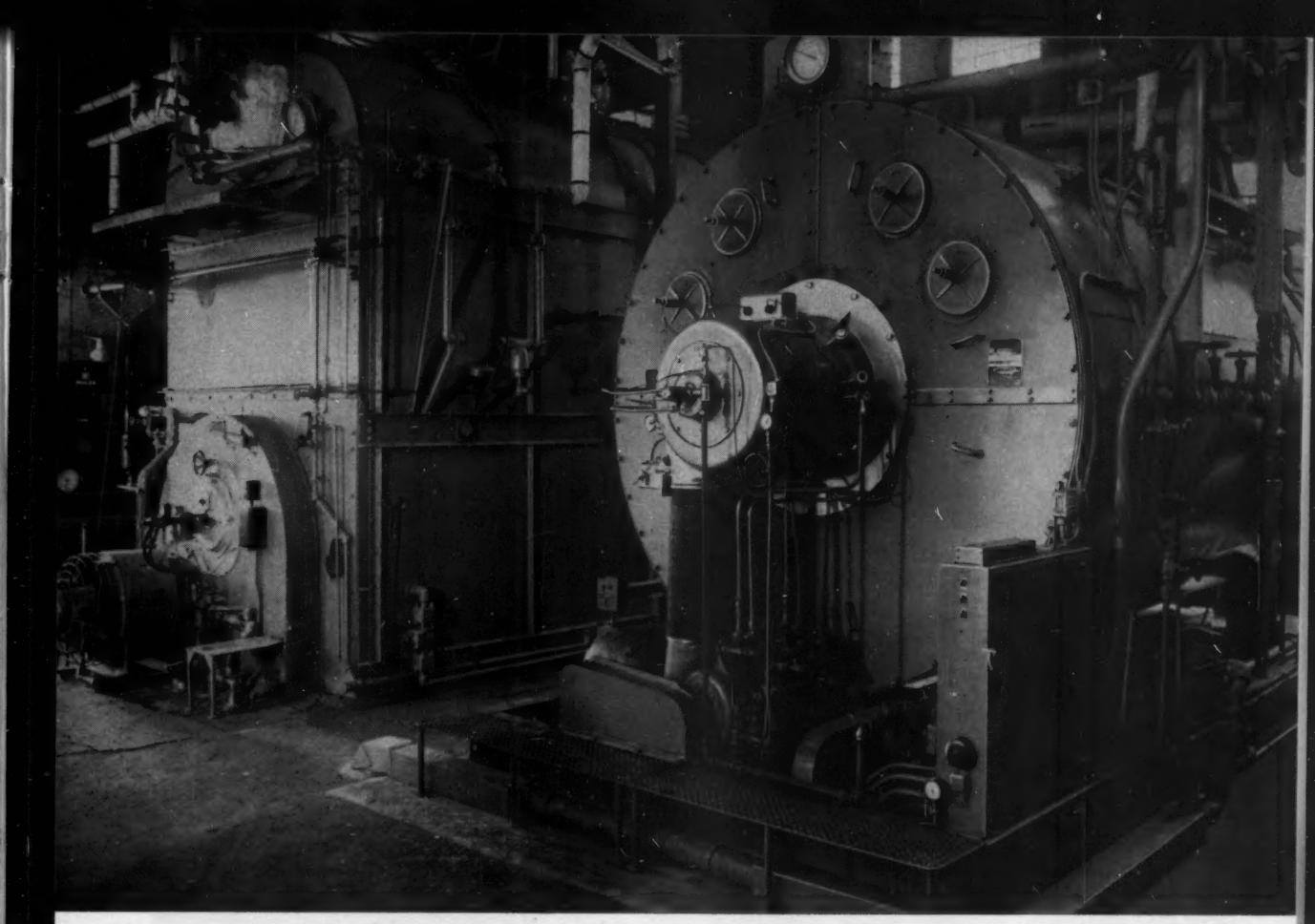
GRAVER® ...Storage equipment for all industries



Why was this *Powermaster*® switched from "Stand-by" to Full-Time Duty?

You get MORE than fuel economy with Powermaster

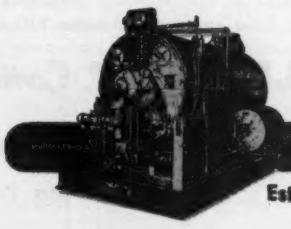
- ★ Low-cost, space-saving installation
- ★ Fast steaming
- ★ Instant response to load changes
- ★ Quick fuel change-overs
- ★ Clean, dry steam
- ★ Automatic operating and safety controls
- ★ Clean, quiet operation
- ★ Smokeless combustion
- ★ One-source responsibility for complete unit
- ★ Nation-wide factory-trained service organization
- ★ Pay-As-You-SAVE Purchase Plan

Originally purchased as a stand-by unit to supplement two older water-tube boilers, this 500 HP heavy oil *Powermaster* Packaged Automatic Boiler was quickly put on full-time duty by an Eastern rubber goods company.

The reason is *Powermaster's* fuel economy. While the *Powermaster* now carries the plant load continuously, the older boilers, one of which is shown at left above, are operated only when necessary.

Powermaster's cost-cutting and worry-saving advantages can be yours quickly and easily under Orr & Sembower's new Pay-As-You-SAVE Purchase Plan.

Write for Bulletin 1220.



Powermaster®

PACKAGED AUTOMATIC BOILERS

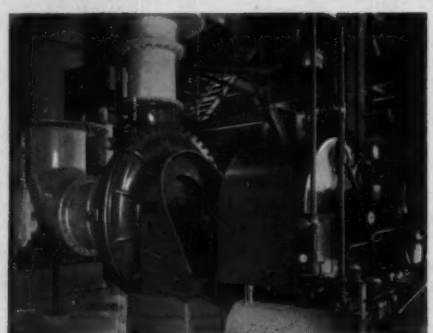
In sizes to 500 HP; pressures to 250 psi.

ORR & SEMBOWER, INC.

Established 1885 • Morgantown Road, Reading, Pa.

This Elliott turbine-driven centrifugal compressor handles a mixture of air and sulphur dioxide. Compressor is rated at 9000 inlet cfm and turbine develops 216 hp at 4700 rpm.
Top team for process plant service

ELLIOTT TURBINE-DRIVEN CENTRIFUGAL COMPRESSORS



Another Elliott turbine-driven centrifugal compressor in sulphuric acid service. Compressor is rated at 21,500 inlet cfm and turbine develops 448 hp at 4010 rpm, exhausting to an Elliott condenser.

Coordination pays off, as the above installation in a sulphuric acid plant in the Southwest demonstrates. This Elliott turbine-driven compressor was finally shut down for overhaul after five years of continuous operation! Even then, the only repairs required were new packing rings for the turbine and new bearings for the compressor. This is a typical performance story for Elliott turbine-driven centrifugal compressors. Each machine is, in itself, tops in its field. Elliott mechanical drive turbines are noted for simplicity and reliability. The compressors are engineered the same way. When teamed together by Elliott engineers, the result is a better-balanced unit, capable of long, sustained service and requiring the minimum in maintenance. For complete information, ask your Elliott field engineer or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

Q6-3

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For higher pressures
—higher temperatures

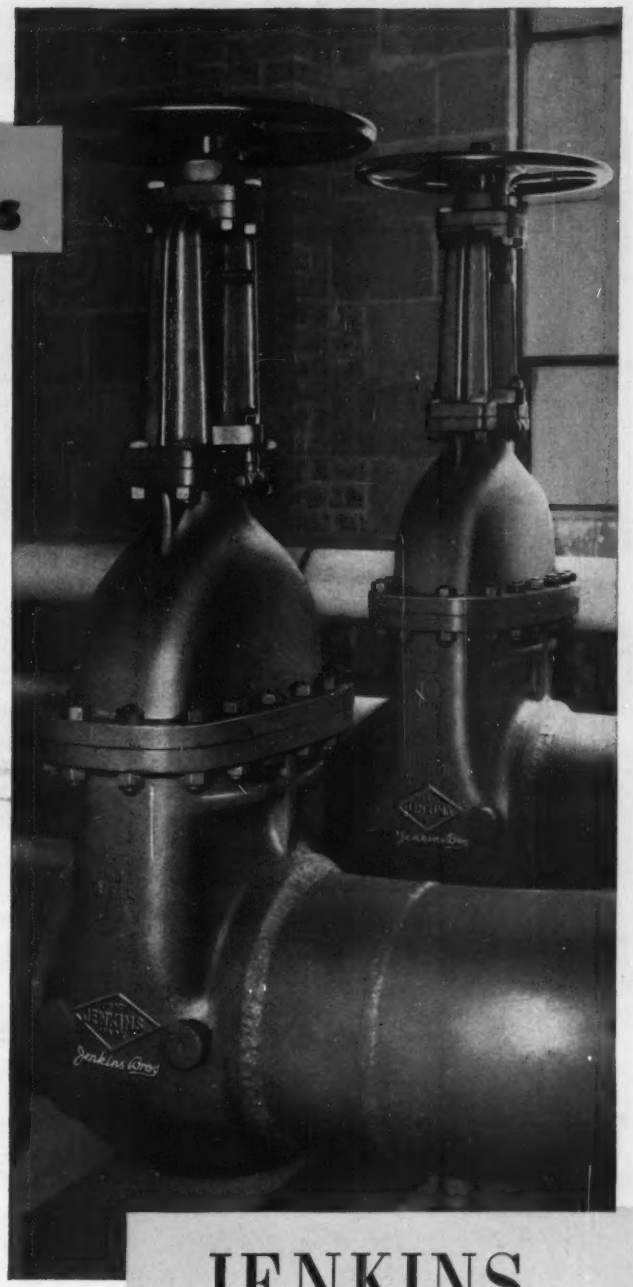
JENKINS CAST STEEL VALVES

serve the systems planned for lowest operating costs

The steadily increasing number of power generation and industrial processing installations of Jenkins Cast Steel Valves is clear evidence of economy-minded selection by valve specifiers and buyers.

Jenkins Cast Steel Valves offer any required combination of casting alloys and seating metals for any service up to 600 lbs. pressure and 1000°F. temperature. Along with specified ratings, buyers get the plus of Jenkins *extra value*, in design, in construction, in quality standards.

Test Jenkins Cast Steel Valves at the most punishing control points in your plant. Compare performance, and you'll see how they set new standards for long-range economy.



PATTERNS

Gates 2" to 24". Globes and Angles 2" to 10". Swing Checks 2" to 12". Non-return, stop and check Globes and Angles 4" to 10".
Screwed, Flanged, or Weld Ends.

PRESSURES

150 lb. — 300 lb. — 400 lb. — 600 lb.

PRESSURE CASTING ALLOYS

Carbon Steel (150 lb.)
Carbon Molybdenum Steel — 300, 400, 600 lb. Valves
Chromium Molybdenum Steel

SEATING METALS

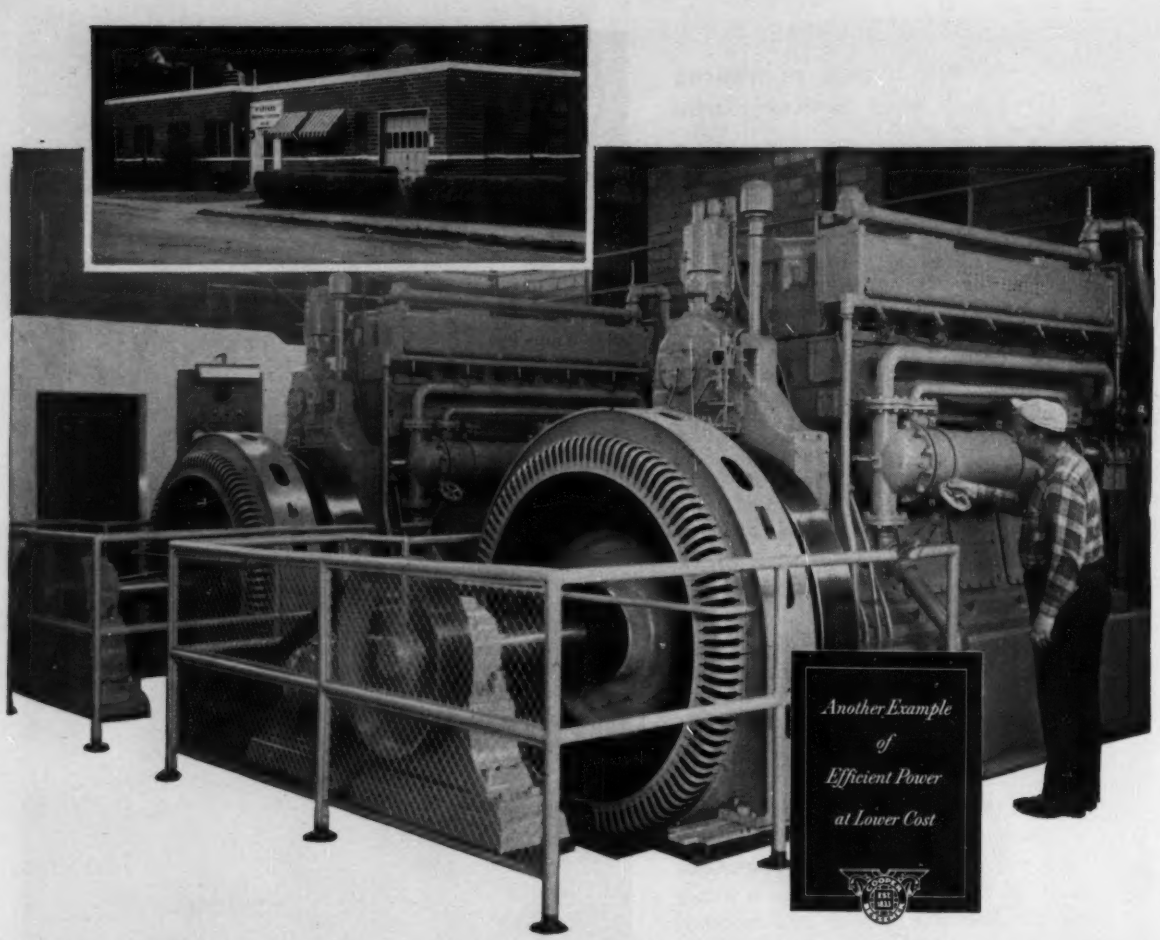
H Monel
13% Chromium Stainless Steel
Carbon Molybdenum Steel, Stellite faced
AISI Type 316 Stainless Steel

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros

FOR COMPLETE SPECIFICATIONS, GET THIS CAST STEEL VALVE CATALOG

It describes all patterns, casting alloys, and seating combinations, with details of the *extra value* design and construction features. Gives pressure-temperature ratings, dimensions, and other technical data. Get a copy from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17.

SOLD THROUGH PLUMBING-HEATING AND INDUSTRIAL DISTRIBUTORS



How McGregor turned a Power Problem into $10,000 yearly profit!

TWELVE years ago, undependable electric power service forced McGregor, Iowa, to build their own plant.

It has proved to be a very profitable investment. Not only is the plant paying for itself . . . last year a net profit of $10,711.62 remained after expenses, depreciation, and bond retirement.

The McGregor plant is powered with two Cooper-Bessemer JS-5 diesels driving 260 kw generators. These atmospheric engines, shown above, are still giving extremely low fuel consumption on 23 gravity diesel fuel oil. Each engine runs four days, continuously. Lube oil is removed, cleaned, and replaced in one engine during the alternate 4-day period. Both engines are occasionally operated at the same time during peak periods.

If you are looking for a completely dependable engine — with exceptional efficiency and unusually low fuel consumption under all loads — be sure to get complete information on Cooper-Bessemer gas-diesels, diesels, and gas engines.

The Cooper-Bessemer Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. New Orleans, La.

NOW! CORROSION-FREE, HIGH-PRESSURE PERMANENT PIPING SYSTEMS

a reality with **Boltaron**

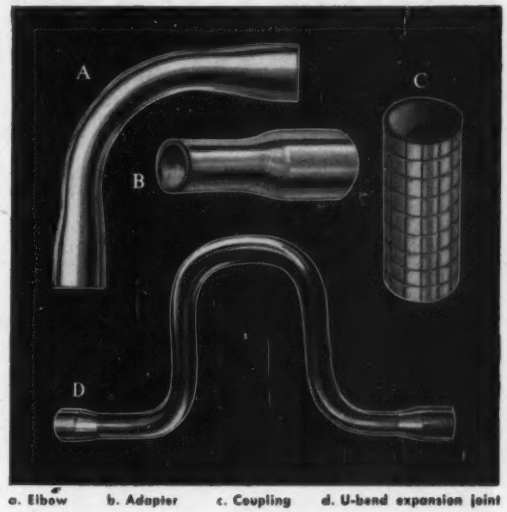
Registered Trademark, The General Tire & Rubber Co., Akron, Ohio

6200 unplasticized PVC (type I)
7200 high-impact PVC (type II)

SHRINK FITTINGS*

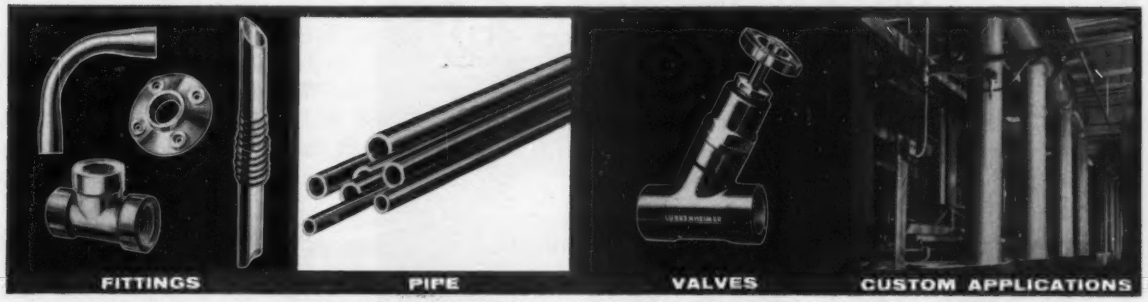
The BOLTARON Shrink Fitting*, a new concept in fitting design, utilizes the "memory" characteristic of thermoplastic materials. With the exception of couplings, both ends of the fitting are belled. The pipe is inserted into the bell which is then heated to shrink to conform to the contour of the pipe. In the case of couplings, the entire fitting is heated and shrinks in the same manner as does the bell fitting. Although the shrink process provides a very tight fit, in most cases cementing is recommended. This is done in synchronism with the shrinking by use of a special heat-curing Boltaron cement. This forms a permanent, leak-proof, air-tight mechanical bond, insuring a corrosion-free, maintenance-free, free-flow piping system with full strength of the pipe.

The Shrink Fitting* eliminates all problems of notch-sensitivity, sediment pockets, turbulence and friction losses and is most effective in long-distance and pressure piping systems.



a. Elbow b. Adapter c. Coupling d. U-bend expansion joint

To insure a uniformly effective system throughout, H. N. Hartwell also stocks a complete line of BOLTARON 6200 and 7200 PVC pipe, valves, conventional fittings and can custom fabricate additional components to meet your specifications.



Conventional fittings, shrink fittings* and roll-thread fittings in full variety of sizes.

A complete line of PVC pipe from ¼" to 6" in schedules 40 and 80.

A complete line of PVC valves in ½" through 2" sizes.

Corrosion-resistant PVC rods, blocks, sheets or pipe that can be fabricated to your specifications.

For additional information, contact:

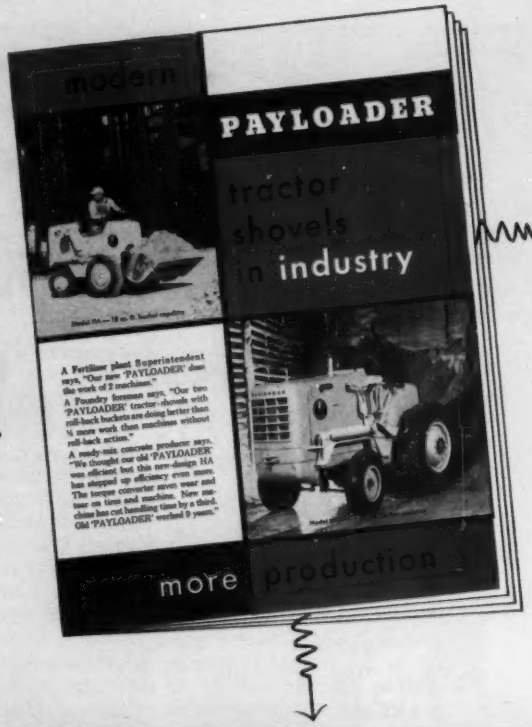
H. N. HARTWELL & SON, INC.

Industrial Plastics Division, Park Square Bldg., Box 105, Boston 16, Massachusetts

The only integrated source for Unplasticized PVC Materials

* Patents applied for

get these first-hand reports of profitable bulk-material handling methods



Continuous, Trouble-Free Service at APOTHECARIES HALL COMPANY

Apothecaries Hall Company is one of the oldest joint stock companies in Connecticut and have been in the fertilizer business more than 100 years. They have been "PAY-LOADER" users since 1942 and now use three model HA's and one larger model HAH. They say, " 'PAYLOADER' units are built for continuous trouble-free service and that's just what we get. The new model HA roll-back bucket increases the delivery load. This is especially true in rail car unloading."

10 Years Satisfactory experience with 10 "PAYLOADER" units at VALIANT FERTILIZER COMPANY

"Our new HA 'PAYLOADER' does the work of 2 machines." Ernest Dickerson, plant supt. of Valiant Fertilizer company, also adds, "This increase is made possible by the roll-back bucket design which carries more bulk material. The low-carrying bucket offers better vision and safety. Torque converter and bucket design gives longer tire wear, less spillage and practically no floor clean-up.

More than 35 years of experience in tractor-shovel design and application has been built into "PAYLOADER" units by The Frank G. Hough Co., originators of the unit-design tractor-shovel. It is this vast experience and knowledge incorporated into the design of each "PAYLOADER" model that makes the big difference in its superior performance on any job.

The new "PAYLOADER" Models HA and HAH include many exclusive features which pay off in greater output per hour. They are small and compact for easy maneuvering and handling in close quarters, yet have ample dumping height for most any job. The 40° bucket roll-back gets full loads fast and, combined with the hydraulic shock absorber, enables the "PAYLOADER" to carry full loads in a higher gear without spillage. These two features are BIG reasons why these machines give more production than heavier machines with bigger engines.

The full-reversing transmission and torque converter provide a wide range of easily obtainable speeds and maximum efficiency in handling each load. Extremely rugged construction . . . finest quality in each component—assures continuous performance with a minimum of "down-time" and a longer useful life.

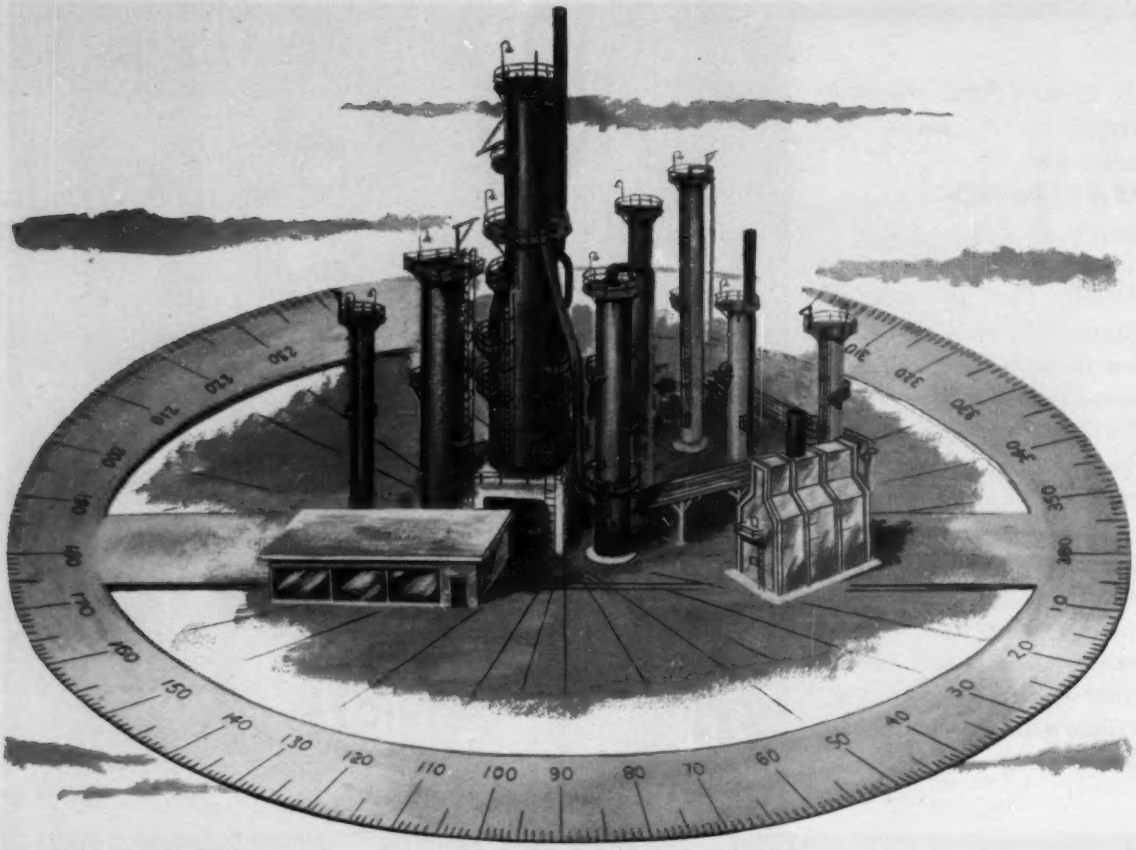
PAYLOADER®
MANUFACTURED BY
THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

It's the difference in performance that has made the "PAYLOADER" the decided choice in thousands of plants throughout the world —there are more in service today than all other makes combined. A "PAYLOADER" is your best investment now — and for the future.

THE FRANK G. HOUGH CO.
754 Sunnyside Ave., Libertyville, Ill.

- ☐ Send profitable bulk-handling reports
- ☐ Literature on model HA (1½ cu. ft.) and model HAH (1 cu. yd.) "PAYLOADER"
- ☐ Literature on larger units to 2¼ cu. yd.

Name_____
Title_____
Company_____
Street_____
City_____
State_____



PROCON COVERS EVERY ANGLE OF CONSTRUCTION

No matter how you look at it, PROCON'S dependable and complete process construction service includes every high standard of efficiency, economy, and quality. Oil refining, chemical, petrochemical companies look with confidence to PROCON for planning, engineering, procurement, construction, and inspection . . . all under ONE responsibility.

Organized to provide the broadest, most flexible services—including new plant construction, additional process facilities, expansion, or modernization—PROCON performs every function *on time*, *economically* and *to specification*.

Before going ahead with building or expansion plans, check with PROCON. Wherever you are, we can serve you well.

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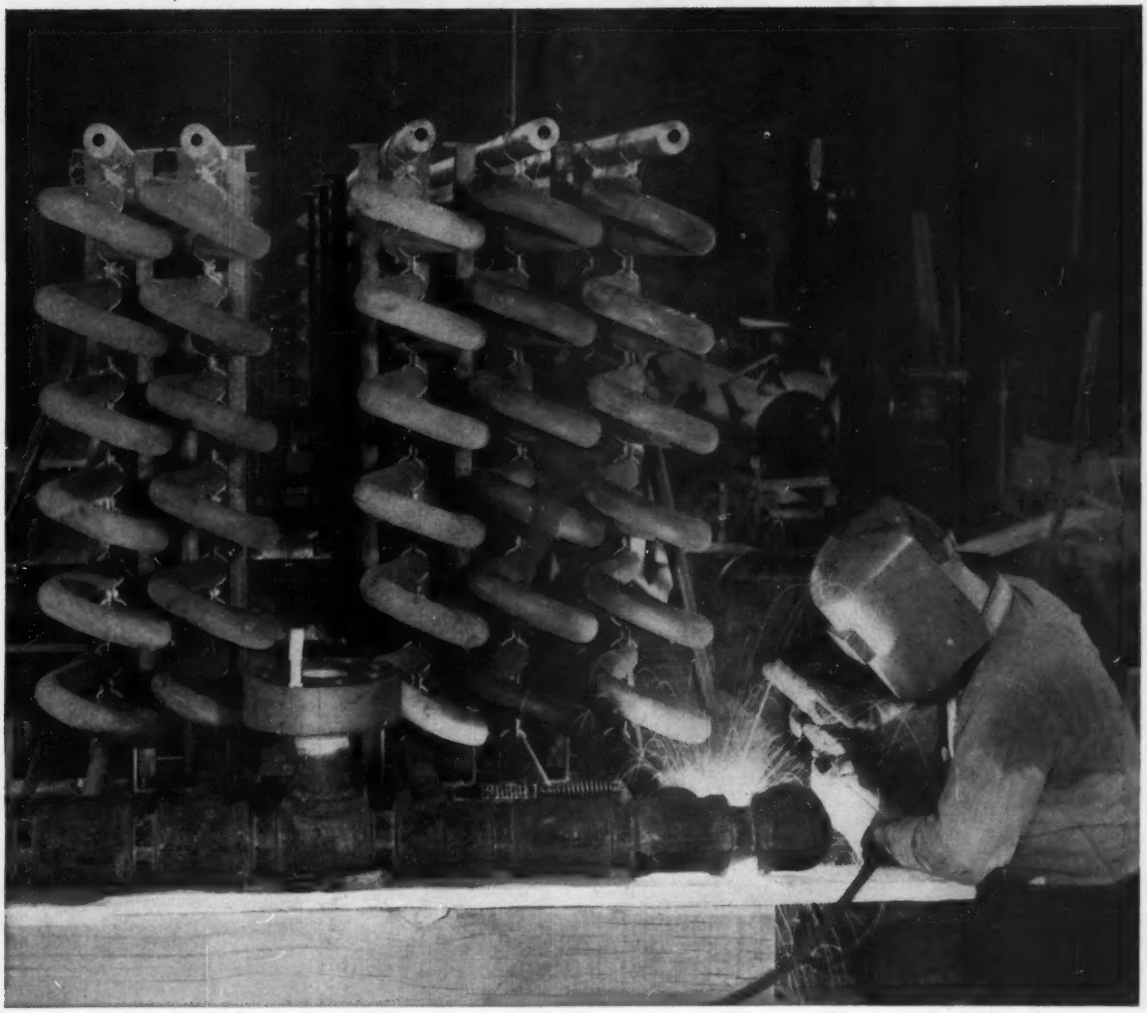
WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES



Putting the Chill on NH_3

The Vilter Manufacturing Co. of Milwaukee, Wis., makes, among other interesting and useful products, ammonia (NH_3) synthesis coolers. These coolers must contain the newly-made hot gas at a pressure of 10,000 psi and reduce its temperature by means of cooling water conducted over the tubes.

To meet its exacting requirements, Vilter chose B&W Seamless Tubing, made for high-pressure service. All tubing in these coolers is tested at 15,000 psi.

To bend these heavy-wall tubes to a 4″ radius, 3⅛″ off the vertical plane, is evidence of Vilter's skill and craftsmanship at work.

And for evidence of how B&W tubing can help improve your own skill and craftsmanship, get in touch with Mr. Tubes, or write for Bulletin 408. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

TA6032-P

Seamless and welded tubular products, seamless welding fittings and flanges—in carbon, alloy and stainless steels

DEPENDABLE, LOW-MAINTENANCE, VACUUM PUMPING

Stokes vacuum pumps remain the standard of comparison for reliable, low-cost performance.

Here's the answer to your high vacuum problems . . . for pilot plant or for production processes. Pump design, based on Stokes pioneering experience in high vacuum equipment, incorporates outstanding features to assure trouble-free performance . . . versatile application.

Minimum maintenance. New mechanical face seal ends oil leakage at the shaft. No stuffing boxes. Fully automatic lubrication.

Wide application. New exhaust valve stops with double springs assure trouble-free operation during extended pumping periods from high to low pressure ranges.

Dirt troubles prevented. New intake screen filter traps dirt, scale and other damaging solids. When necessary, every part of the pump is readily accessible for cleaning.

Extra protection. New oil filter in the line supplies added protection to bearings and shaft seal.

Fail-safe design. If power should fail, a solenoid in the oil line prevents oil flooding of the pump and vacuum system. Microvac pumps offer highest efficiency over entire pressure range . . . are also widely used as high speed fore-pumps in conjunction with booster and diffusion pumps. Write for: Catalog 751, information on vacuum pumps and pumping problems; Stokes' slide-rule vacuum calculator; Booklet 755, "How to care for your vacuum pump" . . . or call your nearest Stokes office. F. J. Stokes Machine Company, *Vacuum Pump Div.*, 5507 Tabor Rd., Philadelphia 20, Pa.

specialists in high vacuum

STOKES

TONNAGE MOLYBDENUM CHEMICALS

To Precise Specifications

AMMONIUM MOLYBDATE, REAGENT

$(NH_4)_6Mo_7O_{24}.4H_2O$ F.W. 1235.95

Meets A.C.S. Specifications

Assay (as MoO_3)	81.0-83.0%
Insoluble Matter	0.005 % Max.
Chloride (Cl)	0.001 % Max.
Nitrate (NO_3)	0.003 % Max.
Phosphate (PO_4)	0.0005 % Max.
Sulfate (SO_4)	0.005 % Max.
Heavy Metals (as Pb)	0.001 % Max.
Magnesium and Allied Cations	0.020 % Max.
pH of 5% Solution at 25°C	5.0-5.5

Particle Size (Mesh): at least 95% thru U.S. No. 20 Sieve
at least 90% on U.S. No. 140 Sieve

AMMONIUM MOLYBDATE, C.P.

$(NH_4)_6Mo_7O_{24}.4H_2O$ F.W. 1235.95

Assay (as MoO_3)	81.0-83.0%
Insoluble Matter	0.010 % Max.
Chloride (Cl)	0.005 % Max.
Nitrate (NO_3)	0.010 % Max.
Phosphate (PO_4)	0.001 % Max.
Sulfate (SO_4)	0.010 % Max.
Heavy Metals (as Pb)	0.003 % Max.
pH of 5% Solution at 25°C	5.0-5.5

Particle Size (Mesh): at least 95% thru U.S. No. 20 Sieve
at least 90% on U.S. No. 140 Sieve

SODIUM MOLYBDATE, TECH. ANHYD.

Na_2MoO_4 F.W. 205.93

Assay (Na_2MoO_4)	98.0 % Min.
Insoluble Matter	0.050% Max.
Chloride (Cl)	0.20 % Max.
Sulfate (SO_4)	0.20 % Max.
pH of 5% Solution at 25°C	9.0-10.0

MOLYBDIC ACID, REAGENT

Meets A.C.S. Specifications

Assay (as MoO_3)	85.0 % Min.
Insoluble in NH_4OH	0.010 % Max.
Chloride (Cl)	0.002 % Max.
Phosphate (PO_4)	0.0005% Max.
Sulfate (SO_4)	0.020 % Max.
Heavy Metals (as Pb)	0.003 % Max.

Particle Size (Mesh): at least 97% thru U.S. No. 40 Sieve
at least 10% thru U.S. No. 325 Sieve

MOLYBDENUM TRIOXIDE, REAGENT

MoO_3 F.W. 143.95

Meets A.C.S. Specifications

Assay (MoO_3)	99.5 % Min.
Insoluble in NH_4OH	0.005 % Max.
Chloride (Cl)	0.002 % Max.
Nitrate (NO_3)	0.003 % Max.
Phosphate (PO_4)	0.0005% Max.
Sulfate (SO_4)	0.020 % Max.
Ammonium (NH_4)	0.001 % Max.
Heavy Metals (as Pb)	0.005 % Max.

Particle Size (Mesh): at least 90% thru U.S. No. 40 Sieve
at least 10% thru U.S. No. 325 Sieve

USES

Molybdenum compounds are widely used in the production of catalysts, phosphomolybdic-phosphotungstic lake colors, molybdate chrome orange pigments, protective and decorative metal finishes, soil additives, and pure molybdenum metal for radio tubes, X-ray tubes, and incandescent lamps. They have specific uses in pharmaceutical, leather and textile manufacture.

In addition to above mentioned Molybdenum Chemicals, Baker also supplies several other Molybdenum Chemicals for industrial use.

Technical product data, samples, and prices will gladly be forwarded upon request.

Address your letter to J. T. Baker Chemical Co., *Executive Offices,* Phillipsburg, New Jersey.

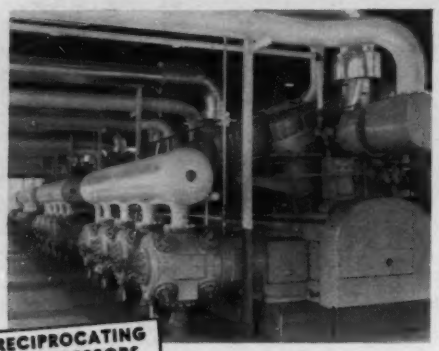
Baker CHEMICAL

Baker Chemicals

REAGENT • FINE • INDUSTRIAL

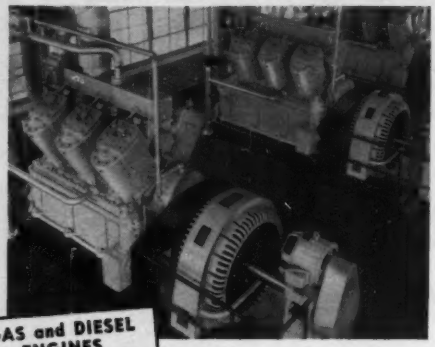
You can depend on I-R equipment

. . . because it's "job-engineered" with design, construction and materials to meet each application



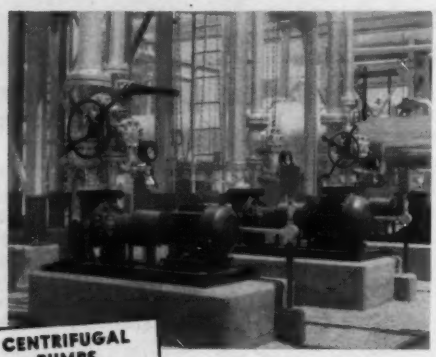
RECIPROCATING COMPRESSORS

Thousands of successful installations have established the dependability of I-R compressors. A complete line is available for handling air and other gases . . . for all types of drive including integral 4-cycle engine-driven units. Sizes range from ½ to 6000 hp; pressures to 35,000 psi.



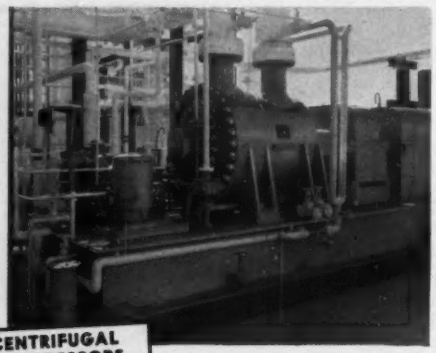
GAS and DIESEL ENGINES

For generating power and for driving pumps, blowers and other types of rotative equipment, Ingersoll-Rand builds a complete line of 4-cycle, V-angle gas engines and 4-cycle, cylinders-in-line diesels. Turbo-charged and naturally aspirated models available in sizes up to 2000 hp.



CENTRIFUGAL PUMPS

For moving liquids in refineries and through pipe lines, Ingersoll-Rand offers a complete line of centrifugal pumps. Single and multi-stage, horizontal and vertical units are available . . . many with built-in mechanical seals. Sizes for all pressures and capacities; for hot and cold liquid service; for all types of drive.



CENTRIFUGAL COMPRESSORS

A complete line of single and multi-stage centrifugal compressors and Turbo-Blowers is made by I-R for catalytic cracking, reforming processes, pipe-line service and for other air and gas applications. Capacities to 160,000 cfm; pressures to 2200 psi. Horizontally split and barrel types are available.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 14-311

Here's a suggestion: Ask your nearest Ingersoll-Rand engineer to tell you more about I-R equipment and how it can best meet your requirements. There are very few phases of petroleum production, refining and transmission that can't benefit in some way from the proved economy and dependability of I-R equipment.

COMPRESSORS . CONDENSERS . PUMPS . DIESEL ENGINES . AIR AND ELECTRIC TOOLS . VACUUM EQUIPMENT

Announcing

TWO GREAT EVENTS FOR MAY 17TH

THE CONSOLIDATION OF THREE GREAT COMPANIES

acf Valve Division, W-K-M Manufacturing Company, Inc., and the Key Company — all members of the acf Industrial Family — have been brought together as W-K-M Manufacturing Company, a subsidiary of acf Industries, Inc.

Management, Manufacturing and Marketing facilities of all three are now centralized in this new 12-acre completely air-conditioned office and plant at Missouri City, Texas, a few miles west of Houston.

This consolidation provides important efficiencies of production of W-K-M Through-Conduit Valves, acf Lubricated Plug Valves, Key Return Bends, and Key-Kast Welding Fittings. These products, with a long established reputation for excellent service and performance, will continue to be engineered, manufactured and sold by the same experienced personnel who were instrumental in building that reputation.

OPENING OF A GREAT NEW PLANT THURSDAY, MAY 17TH NOON TO 8 P. M.

You are cordially invited to inspect our new Plant and Office at Missouri City, Texas, just a few miles west of Houston.

Special transportation from downtown Houston to the plant will be provided for visitors. Please write immediately for your Transportation Pass. Address W-K-M Manufacturing Company, Guest Committee, P. O. Box 2117, Houston, Texas.

W-K-M MANUFACTURING COMPANY, INC.

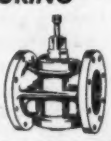
A SUBSIDIARY OF acf INDUSTRIES INCORPORATED

PLANT: MISSOURI CITY, TEXAS • MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

MANUFACTURING

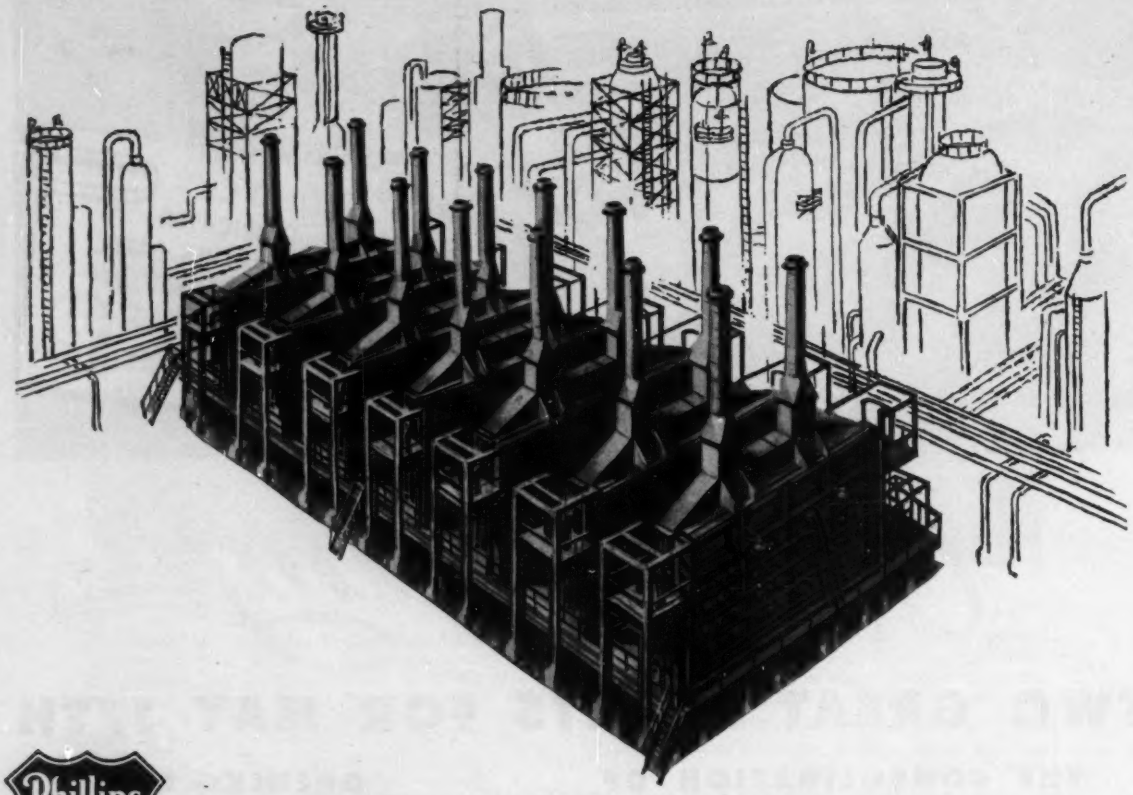
W-K-M THROUGH-CONDUIT GATE VALVES

acf LUBRICATED PLUG VALVES



KEY RETURN BENDS AND FITTINGS

IN ETHYLENE PRODUCTION...



Phillips 66 too, will soon benefit ...from SELAS Gradiation® Heating

A battery of seven Gradiation Heaters is now in the engineering stage at Selas for use in Phillips' new ethylene plant at Sweeney, Texas.

Based on their previous experience with Selas Heaters in ethylene service, Phillips knows it can expect:

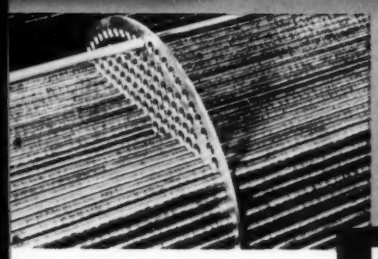
- Operation at the designed capacity from the moment of startup.
- "On stream" periods, without shutdown, well in excess of 30 days.
- High conversions and selectivity.
- Versatility in processing widely different feed stocks.
- Zone Control of heat input, which enables meeting any time-temperature curve in pyrolytic or catalytic reactions and high temperature preheating.
- Uniform heat distribution on the entire tube surface extends tube life by eliminating local overheating and material degradation at the tube wall.
- Controlled combustion, with little or no excess air to cause external oxidation of the tubes . . . no lag in response to controller demand.

Send for copy of reprint, "Try the Gradiation Heater for Economical Ethylene Production" and Bulletin 115 "Gradiation Heating for Petroleum and Chemical Processing."

SELAS
CORPORATION OF AMERICA
DRESHER, PENNSYLVANIA

Heat and Fluid Processing Engineers

DEVELOPMENT • DESIGN • CONSTRUCTION



STARTLING APPLICATIONS OF INCREASED HEAT TRANSFER

Using WOLVERINE TRUFIN* Type S/T

• CONDENSING STRAIGHT RUN GASOLINE

Located in the plant of a large Mid-West refinery this condenser, originally a plain tube unit, was retubed with Wolverine Trufin Type S/T. Here are the basic facts:

	PLAIN TUBE	TRUFIN TYPE S/T
TOTAL TUBE LENGTH	16,384	10,916
OUTSIDE SURFACE, SQ. FT.	3,215	5,420
METAL	14 BWG Admiralty	16 BWG (Cat. No. 195065) 90-10 Cu. Ni.

RESULTS:

The heat duty of the Trufin-tubed unit was 630,000 BTU's per hour greater than the plain tube condenser. Trufin's performance per foot of length, was 80% greater than the plain tube. In nearly two years of service, the Trufin unit has never required mechanical cleaning. Acidizing every four months has been adequate.

CONCLUSION: *Trufin is a Wise Buy!*

• CONDENSING ORGANIC CHEMICALS

The following data is based on the condensation of Freon-12 with water and was compiled after exhaustive tests under closely controlled conditions:

	PLAIN TUBE	TRUFIN TYPE S/T
SHELL SIZE O. D.	12¾"	12"
TUBE LENGTH	7'	7'
TUBE SPECIFICATIONS	⅝" O.D.—18 BWG 90-10 Cu. Ni.	⅝" O.D.—18 BWG (Cat. No. 195049) 90-10 Cu. Ni.
OUTSIDE SURFACE SQ. FT.	143.34	334.0

RESULTS:

On the basis of equivalent water velocity the prime surface unit extracted 411,000 BTU's per hour. The Trufin-tubed unit obtained 829,000 BTU's per hour.

CONCLUSION: *Trufin is a Wise Buy!*

• CONDENSING CRACKED GASOLINE

When tubed with plain tube, this superstructure mounted condenser, had to be mechanically cleaned every three months. In an effort to boost capacity, extend on-stream time, and eliminate the necessity of designing new exchangers, it was retubed with Wolverine Trufin Type S/T. Here are the vital statistics:

	PLAIN TUBE	TRUFIN TYPE S/T
NO. OF TUBES	500	500
OUTSIDE SURFACE AREA, SQ. FT.	1522	3280
METAL, ¾" O. D.	16 BWG Admiralty	16 BWG (Cat. No. 195065) Admiralty

RESULTS:

Heat duty jumped from 3,960,000 to 5,820,000 BTU's per hour with the Trufin bundle. Retubing permitted a 38% increase in throughput and a 47% increase in heat removal with a very large increase in length of run.

CONCLUSION: *Trufin is a Wise Buy!*

These are but three of many installations where Trufin is injecting greater performance into existing equipment. When retubing existing condensers or designing new ones, always specify Trufin Type S/T. For further information complete with case histories and design data, write for your copy of Wolverine's Trufin Opportunity Book. Do it today!
WOLVERINE TUBE, 1443 Central Avenue, Detroit 9, Michigan.

*REG. U.S. PAT. OFFICE

PLANTS IN DETROIT, MICH. AND DECATUR, ALABAMA.
SALES OFFICES IN PRINCIPAL CITIES

EXPORT DEPARTMENT, 13 EAST 40TH ST., N.Y. 16, N.Y.

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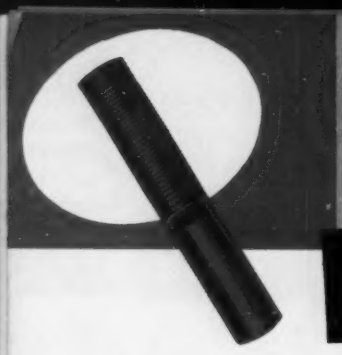
WOLVERINE TUBE DIVISION
CANADA VULCANIZER & EQUIPMENT CO., LTD.
FOREST INDUSTRIES DIVISION
GOODMAN LUMBER CO.

WOLVERINE TUBE

Division of Calumet & Hecla, Inc.

Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes



STARTLING FACTS ABOUT HEAT TRANSFER

Where and how WOLVERINE TRUFIN* Type S/T Can Help You CUT COSTS, BOOST PERFORMANCE!

CHECK LIST

OF TRUFIN TYPE S/T ADVANTAGES THAT WILL HELP YOU SAVE

Trufin—with fins squeezed directly from the tube wall—has more than twice the heat transfer surface of plain tube. You need less tube because Trufin transfers more BTU's per foot of tube!

Fewer tubes mean smaller shells, headers, baffles . . . substantial savings in material requirements!

Less tubes mean less holes to drill—fewer rolling-in operations . . . a direct saving in time and labor costs!

Trufin requires much less over-all tube metal to transfer a given heat load. This means a real saving when expensive alloys are necessary . . . vital when alloys are in short supply!

Because Trufin installations require fewer tubes you can often design lighter units. Think of what this means when superstructure mounting is required!

Maintenance costs go down and stay down. Replacement tube costs are reduced, on-stream time increases because fewer tubes mean less cleaning time is necessary. Actual operating data shows that Trufin withstands fouling for longer periods of time than does prime surface tube. Operating time between change-overs is lengthened!

Trufin is completely interchangeable with prime surface tube. You follow standard retubing techniques!

Trufin withstands vibration, sudden temperature changes and pressure variations. Fin life is equal to that of the tube itself.

On the left, below, you'll find some basic reasons for the outstanding performance of Wolverine Trufin Type S/T—the integral finned condenser tube. You'll also find, below, a partial list of operations where Trufin can be used to good advantage. Study both lists carefully—check them against your own heat exchange operations—see for yourself just where and how Trufin can help you do a better job.

A FEW OF THE APPLICATIONS WHERE TRUFIN TYPE S/T CAN HELP YOU

In Butane Condensers

In Propane Condensers

In Gasoline Condensers

In Isopropyl Condensers

In Condensing Butyl Heads

In Gas Coolers

In Condensing Organic Chemicals

In Boiling Hydrocarbons

In Heating or Cooling Gases

In Heating or Cooling Oil or other liquid Hydrocarbons

As we have said—study these points. They can be your check list to greatly increased efficiency and economy in your heat exchange applications. Wolverine's new Process Flow Sheet Book contains many drawings of actual Trufin installations. Write today for your copy. WOLVERINE TUBE, 1443 Central Avenue, Detroit 9, Michigan.

Wolverine Trufin available in Canada through the Unifin Tube Company, London, Ontario.

*REG. U.S. PAT. OFFICE

565W42—5186

DIVISIONS OF CALUMET & HECLA, INC.
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CANADA VULCANIZER & EQUIPMENT CO., LTD.
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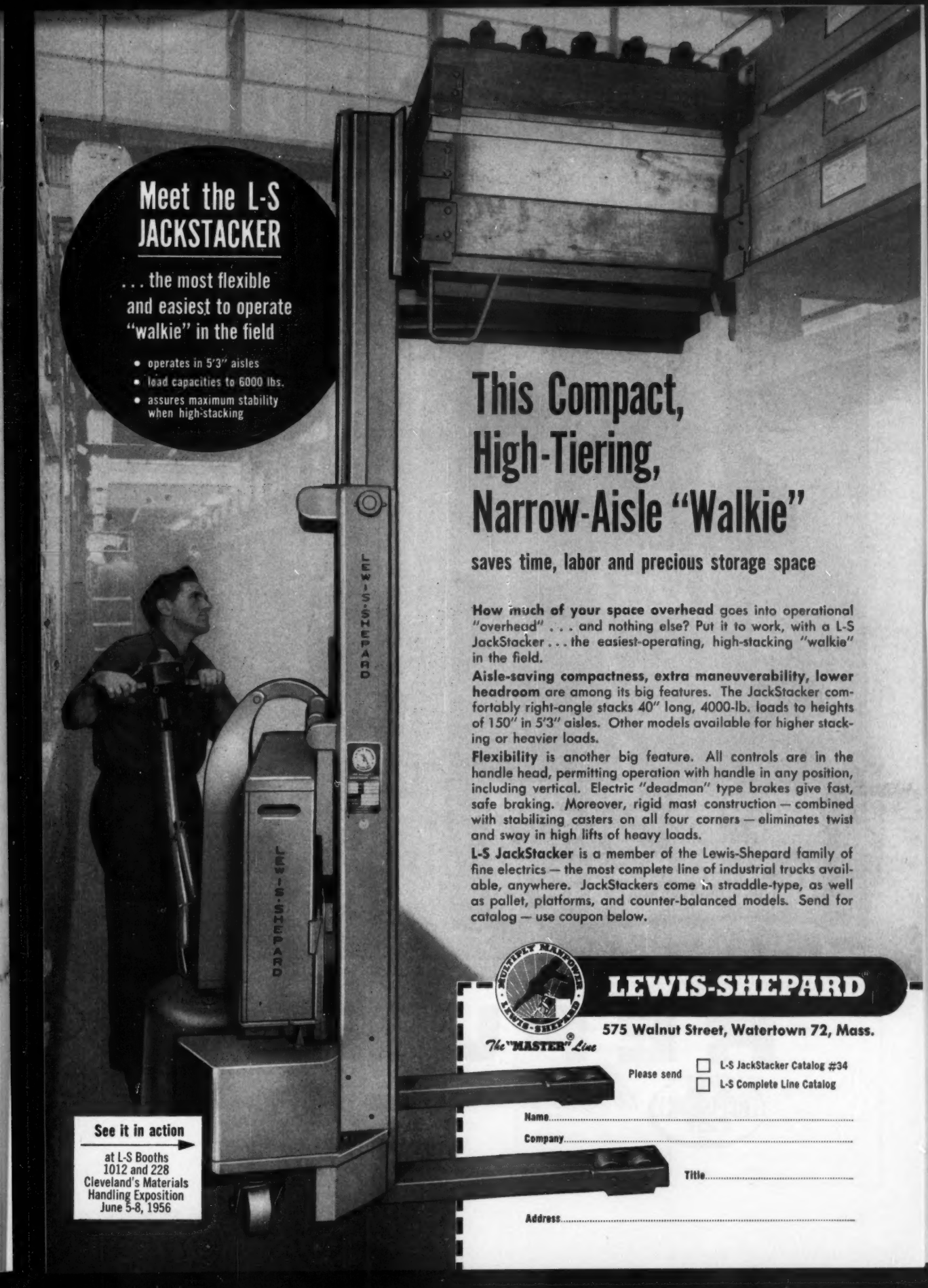
GOODMAN LUMBER CO.

WOLVERINE TUBE

Division of Calumet & Hecla, Inc.

Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.
EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, NEW YORK


Meet the L-S JACKSTACKER
. . . the most flexible and easiest to operate "walkie" in the field
• operates in 5'3" aisles
• load capacities to 6000 lbs.
• assures maximum stability when high-stacking
LEWIS-SHEPARD
LEWIS-SHEPARD
See it in action
at L-S Booths 1012 and 228 Cleveland's Materials Handling Exposition June 5-8, 1956

This Compact, High-Tiering, Narrow-Aisle "Walkie"

saves time, labor and precious storage space

How much of your space overhead goes into operational "overhead" . . . and nothing else? Put it to work, with a L-S JackStacker . . . the easiest-operating, high-stacking "walkie" in the field.

Aisle-saving compactness, extra maneuverability, lower headroom are among its big features. The JackStacker comfortably right-angle stacks 40" long, 4000-lb. loads to heights of 150" in 5'3" aisles. Other models available for higher stacking or heavier loads.

Flexibility is another big feature. All controls are in the handle head, permitting operation with handle in any position, including vertical. Electric "deadman" type brakes give fast, safe braking. Moreover, rigid mast construction — combined with stabilizing casters on all four corners — eliminates twist and sway in high lifts of heavy loads.

L-S JackStacker is a member of the Lewis-Shepard family of fine electrics — the most complete line of industrial trucks available, anywhere. JackStackers come in straddle-type, as well as pallet, platforms, and counter-balanced models. Send for catalog — use coupon below.

MULTIPLY MANPOWER · LEWIS-SHEPARD

The "MASTER" Line

LEWIS-SHEPARD

575 Walnut Street, Watertown 72, Mass.

Please send ☐ L-S JackStacker Catalog #34
☐ L-S Complete Line Catalog

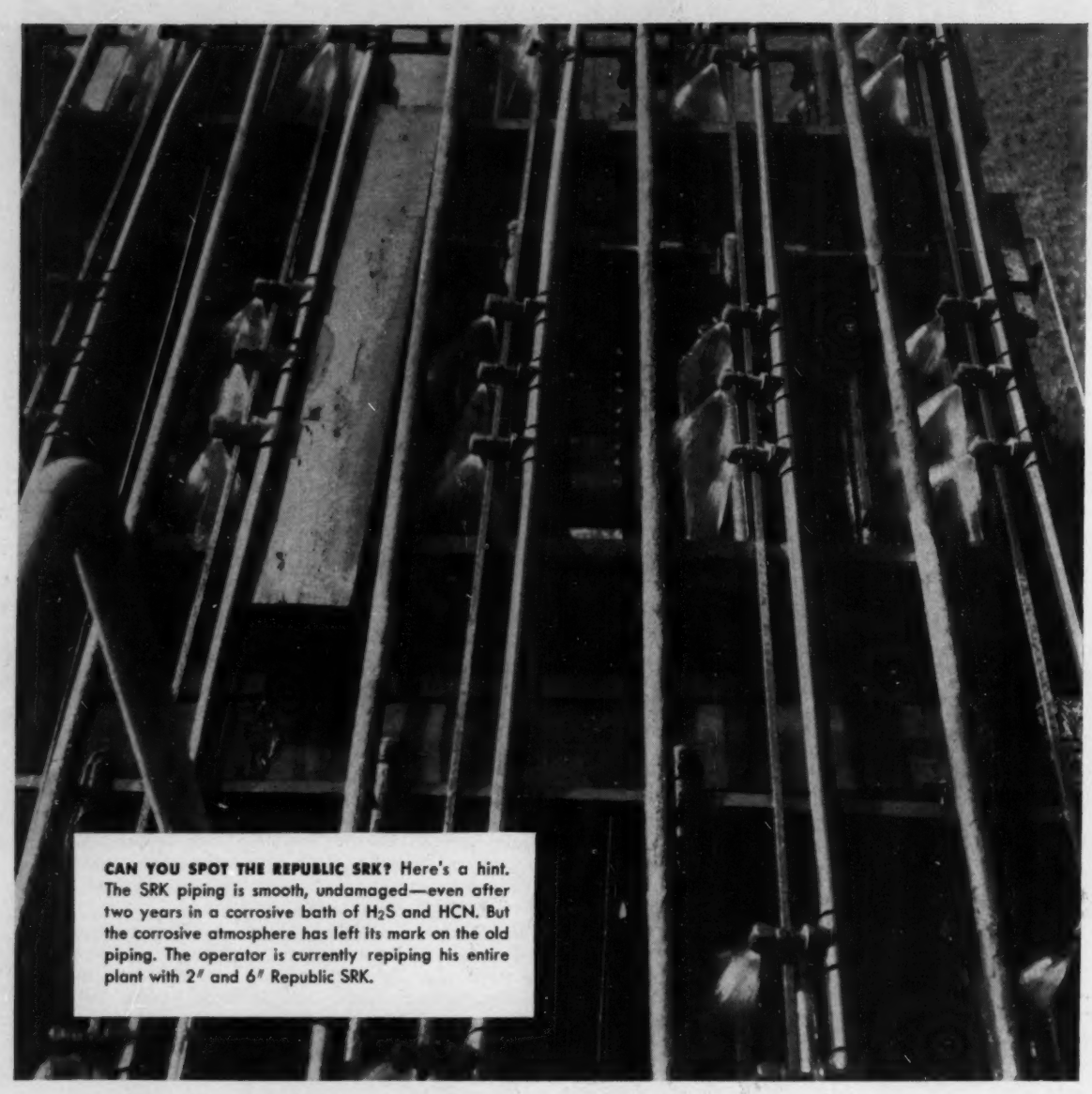
Name.....

Company.....

Title.....

Address.....

Plastic Pipes in Spray Cooler



CAN YOU SPOT THE REPUBLIC SRK? Here's a hint. The SRK piping is smooth, undamaged—even after two years in a corrosive bath of H_2S and HCN. But the corrosive atmosphere has left its mark on the old piping. The operator is currently repiping his entire plant with 2″ and 6″ Republic SRK.

REPUBLIC

REPUBLIC STEEL

World's Widest Range of Standard Steels

Outlast Old Piping 4 to 1

Republic SRK is still like new after rugged two-year corrosion test

The piping in that radiator-type cooler (left) is in a tough spot.

Hot coke on a nearby platform is quenched with water, enveloping the entire area in steam saturated with Hydrogen Sulphide and Hydrogen Cyanide. Every piece of equipment not resistant to the corrosive effects of acids is vulnerable.

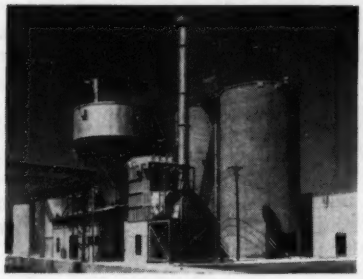
The piping in the cooler, for example, became irreparably damaged after six months' service and had to be replaced. Each year the repair bill got bigger.

To solve this problem, the operators installed Republic SRK—the amazing, corrosion-resistant plastic pipe. Today, after two years, there are absolutely no signs of damage or wear.

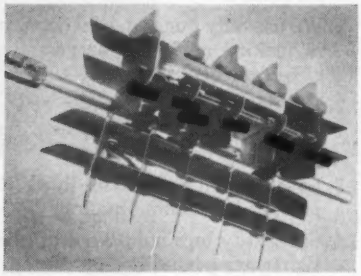
Within its temperature and pressure limitations, Republic's SRK will prove ideal for many applications in the chemical and food processing industries—in both waste and process lines. It's highly resistant to a long list of corrosive liquids and gases. Being extremely tough, it will absorb terrific punishment without breaking or shattering.

Republic SRK is lightweight, easy to carry. It cuts quickly, is easily joined by simple solvent-welded sleeve-type fittings. SRK is approved by the National Sanitation Foundation as safe for carrying potable liquids.

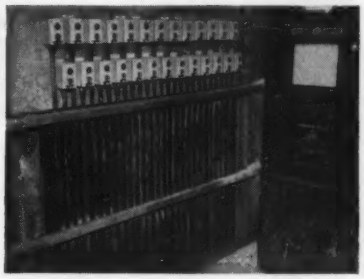
Modern techniques and highest standards of quality control result in wall sections of uniform strength throughout each length. Republic SRK comes in three working pressures—with specific sizes for each (straight lengths only). Pipe of 150 lb. rating is available in sizes ½″ through 2″; pipe of 100 lb. rating—in sizes 2″ through 6″; 75 lb. rated pipe—in sizes 3″, 4″ and 6″. Republic also supplies SRB and FE Plastic Pipes. If you have a problem, write us. We can recommend the proper pipe for the job. Send coupon for literature.



STAINLESS STEEL protects this evaporative dryer, used in the manufacture of kaolin for the coated paper industry. Equipment made from Republic ENDURO® Stainless Steel *stays* on the job, requires only minimum maintenance. ENDURO is easy to keep clean and attractive, protects purity, and safeguards other chemicals from side reactions or contamination. Republic can help you and your supplier apply ENDURO qualities and benefits efficiently and economically. Send coupon for more information.



TITANIUM offers properties, such as extremely high corrosion-resistance, that warrant its increased use in solving manufacturing and processing problems. Recently one manufacturer of ice cube trays and grids switched anodizing racks from aluminum to Republic Titanium—increased the life of the racks 100 times! Titanium was unaffected by chemical, etching, brightening and anodizing solutions. An expensive stripping operation was also eliminated. If you have a severe service problem, write Republic.



DEKORON®-COATED E.M.T., a product of Republic's Steel & Tubes Division, is recommended where electrical wiring must be protected in corrosive atmospheres. Its tough, polyethylene coating over the galvanized finish actually provides double protection. Moistureproof joints are easily made using threadless connectors and couplings and wrapping with plastic tape. Ordinary conduit in above application formerly corroded out every five years. Republic Dekoron-Coated E.M.T. has solved this problem. Send coupon for literature.

STEEL

and Steel Products

REPUBLIC STEEL CORPORATION
Dept. C-1627
3116 East 45th Street, Cleveland 27, Ohio

Please send more information on:

- ☐ SRK Plastic Pipe
- ☐ SRB Plastic Pipe
- ☐ FE Plastic Pipe
- ☐ ENDURO Stainless Steel
- ☐ Titanium
- ☐ Dekoron-Coated E.M.T.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

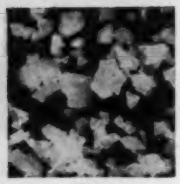
BRIEFS for buyers of

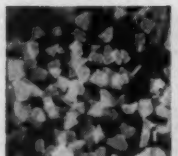
Sodium Sulfide
Sodium Sulfhydrate
Flake Caustic Soda

Especially good for repackaging (as in cleansers and other specialties) are these four sizes of Hooker flake caustic soda, all shown actual size.

"Regular," "fine," and "crystal" sizes are nondusting. And with these flakes, you're sure of actually *getting* the size you order. In a tightly-controlled flaking-screening operation, we make the flakes just thick enough to stand up well and stay the same size in transit.

Regular


Fine


Crystal

Powdered

Regular flake is shipped in 100-lb. and 400-lb. steel drums; the other sizes in 450-lb. steel drums. The larger drums come in two styles: 14-inch opening (extra large for easy emptying), or full open head (at slight extra cost).

For data sheet, check the coupon. For test samples, just write and tell us the sizes you'd like.

A tanner could tell you what can happen when sodium sulfide picks up iron.

When this happens in a tannery, the leather is likely to develop blue blotches.

The five steps we take to help *tanners* avoid this situation hold meaning for *you*, if you process with sodium sulfide.

1. We use only our own caustic soda in making sulfide. This gives us close control of its composition.
2. We never re-use a sulfide drum. You receive every shipment in brand new containers.
3. Every drum is lacquer-lined to prevent iron contamination.
4. Six sturdy lugs hold the drum lid tight during handling and storage. They're handy for re-sealing the drum, too.
5. We individually lacquer the lid of every drum, to make an airtight seal that keeps the product at full strength.

The clean, strong flakes dissolve right into process, even without stirring. No waiting; no decanting.

You've probably gathered by now that sodium sulfide, at Hooker, is a specialty of the house. You're right. And that's a good reason why you stand to get maximum satisfaction with ours.

The flake form is shipped in 90-lb. and 350-lb. drums. Solid form comes in 625-lb. drums. Why not order a trial quantity?

Better pH control

What we said about sulfides also goes for Hooker *sodium sulfhydrate*, with this important difference:

Some processors are switching to our sulfhydrate, as a replacement for sodium sulfide. Why?

When sulfhydrate goes into solution, it forms less caustic soda than does sodium sulfide. Only half as much, in fact. So these processors are able to get more sulfidity, with less alkalinity, by using sulfhydrate. Maybe there's an idea here for your processing operations, if high pH is a problem in sulfide solutions.

Hooker sodium sulfhydrate dissolves rapidly, even in cold water. There's virtually no sedimentation even after long standing. You can get it in 90-lb. and 350-lb. drums. For more details, check the coupon.

For Technical Data Sheets

on Hooker chemicals mentioned on this page, check here:

- ☐ Sodium Sulfide
- ☐ Sodium Sulfhydrate
- ☐ Caustic Soda

How up-to-date is your caustic data file? If you're a user of liquid caustic soda, here's some recent material to help you buy better:

- ☐ Caustic Soda Buyer's Guide. Pocket-size booklet lists advantages of 73% and 50% caustic concentrations; comparative costs; includes nomograph for figuring savings with 73%.

Clip and mail today with your name, title, company address.

HOOKER CHEMICALS

From the Salt of the Earth

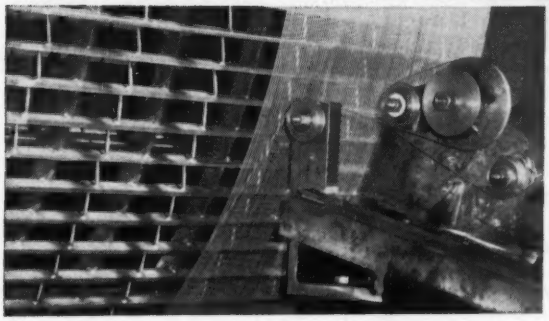
HOOKER ELECTROCHEMICAL COMPANY

8 FORTY-SEVENTH STREET, NIAGARA FALLS, N. Y.

NIAGARA FALLS · TACOMA · MONTAGUE, MICH. · NEW YORK · CHICAGO · LOS ANGELES

S-1710

CAN YOU AFFORD TO TAKE A CHANCE ON PRODUCT CONTAMINATION?



The company buying this stock washer can't, so stainless steel was specified for all parts in contact with the product. High quality standards will be easier to maintain . . . rejects fewer.

STAINLESS GUARDS QUALITY, CUTS COSTS

Filters and stock washers are only a few of many kinds of chemical processing equipment in which you can cut down on contamination by corrosion products, rust or scale with Armco Stainless Steels. And the smooth, hard surface of stainless is easy to keep clean.

Easy cleaning and the durability of stainless units also assure low maintenance costs and long service life. Costly down-time is reduced to a minimum.

SELECT THE GRADE THAT MEETS YOUR NEEDS

Armco offers you the choice of more than 50 standard and special grades of stainless. You can select the *one* that best suits your needs. For example, with Armco's new precipitation-hardening stainless steels you get a combination of *good* corrosion resistance, unusually high strength and easy fabrication.

Specify Armco Stainless Steel for your processing units, valves, pumps and other product handling equipment. You'll find it pays off in more uniform quality of your products and lower operating costs.

We'll be glad to send you helpful information on the Armco Stainless Steels that are especially advantageous in chemical processing. Just fill out and mail the coupon.

ARMCO STEEL CORPORATION
1356 Curtis Street, Middletown, Ohio

We are interested in stainless for:_____

_____

Please send me data on the Armco Stainless Steels which offer special advantages in this application.

NAME_____

COMPANY_____

STREET_____

CITY_____ ZONE____ STATE_____

ARMCO STEEL CORPORATION

1356 CURTIS STREET, MIDDLETOWN, OHIO

SHEFFIELD STEEL DIVISION • ARMCO DRAINAGE & METAL PRODUCTS, INC. • THE ARMCO INTERNATIONAL CORPORATION

Using Salt Efficiently

by **INTERNATIONAL SALT COMPANY, INC.**—America's largest producer of salt

Three Methods of Measuring Salt—and Their Effects on Brine Uniformity

One of the most important factors in maintaining brine strength at consistently uniform levels is salt measurement. When measurement is inaccurate, brine may be weakened excessively or become too strong. But, when salt is measured accurately, variations in brine strength are virtually eliminated . . . brine production costs are reduced . . . and product quality remains high.

Today, there are three methods commonly used to measure salt in industry. While all of these have certain merits, only one method is completely accurate—measuring salt quantity in the form of saturated brine. A look at the other two methods will show why they are not entirely reliable.

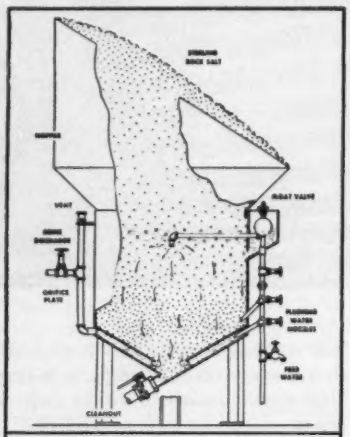
Measurement by dry salt volume. This method presents a number of difficulties. First, moisture content of salt can greatly affect its volume. And humidity changes alter this moisture content to a considerable degree. Degree of compaction makes a big difference in volume, too. A pailful of salt may vary from 25 to 35 lb. (a 40% margin of error) depending on storage conditions, or length of storage. Both moisture content and compaction will change, not only from one day to the next—but also from one batch of salt to another.

Measuring by dry salt weight. This method is somewhat more reliable, but is still far from accurate. When the scale reads 100 lb., it can never be estimated how much of that weight is moisture—one pound or ten. And again, the moisture content of salt varies constantly with air humidity, and humidity of storage areas. When salt is measured this way, control over brine strength is never exact.

Measurement by the saturated brine method. This is effective in every industrial application. It depends, of course, on fully saturated, crystal-clear brine, free from any undissolved solids. One gallon of such brine always contains 2.65 lb. of salt (if dissolution water temperature is within the range found in most plants). By starting with this accurate fixed unit of salt measurement, brine strength can be completely controlled. Whatever strength is desired—the dilution of fully saturated brine with a certain amount of water produces it quickly and accurately.

One of the best ways to get the fully saturated brine essential to this measuring method is with a Lixate Rock Salt dissolver. This device—originated by International—automatically produces clear, fully saturated brine from Sterling Rock Salt. In fact, development of the Lixator made possible accurate salt measurement.

Regulating brine strength with the Lixator: Water is run into storage tank up to a specified mark. Lixate Brine is then added to bring the volume up to another mark. The mixture of water and Lixate Brine will give the exact strength of dilute brine needed—as well as the correct volume.



The Sterling Lixator reduces salt-handling, brine-making and brine-distributing costs. Savings between 10% and 20% on salt used are possible, too.

This method of salt measurement and brine control, of course, does more than protect product quality. It also provides substantial savings in time and labor—since the entire Sterling Lixator operation is fully automatic.

TECHNICAL SERVICE WITH YOUR SALT

Through skilled and experienced "Salt Specialists," International can help you get greater efficiency and economy from the salt you use. International produces both Sterling Evaporated and Sterling Rock Salt in all grades. We also make automatic dissolvers in metal or plastic for both types of salt. So we can suggest the type and grade of salt most perfectly suited to your needs.

If you'd like help on any problem concerning salt or brine—or further information on salt measurement—contact your nearest International sales office.

International Salt Co., Scranton, Pa.
Sales offices: Atlanta, Chicago, New Orleans, Baltimore, Boston, Detroit, St. Louis, Newark, Buffalo, New York, Cincinnati, Cleveland, Philadelphia, Pittsburgh, Richmond.

FOR INDUSTRY, FARM, AND THE HOME—
STERLING SALT
PRODUCT OF INTERNATIONAL SALT CO., INC.

The Year Advertising Helped

IN 1954 we had a business recession in the United States. Sales fell about 4% during the year. If management had followed the historic pattern of business ups and downs, advertising volume would have fallen much further.

But in 1954 the volume of advertising did not fall. It increased over 5%. Every effort was made to stimulate sales when sales were needed to sustain prosperity.

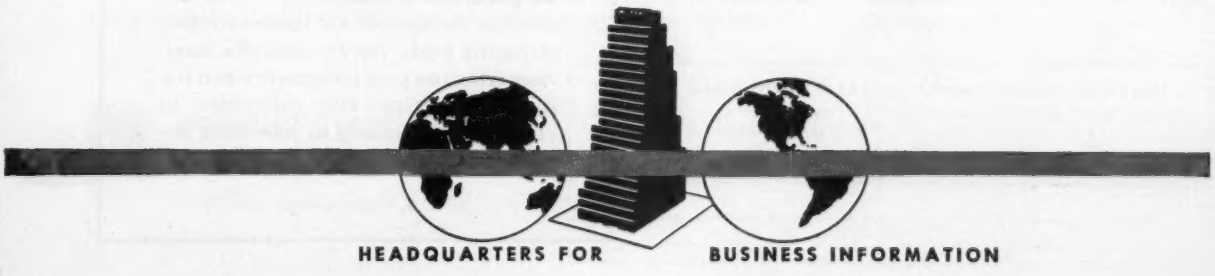
This was something entirely new under the sun. It had a powerful influence in making the recession of 1953-54 one of the mildest on record. It helped greatly to speed business on to the record-breaking levels it has attained today.

There are several reasons why America's business management attacked this decline in sales with more advertising. One of them grew out of the greatly strengthened position of the American consuming market. Consumers' income after taxes has been rising an average of over $10 billion a year since 1946, and this rising income is more widely distributed than ever before. Furthermore, consumers have piled up reserves of about $215 billion in cash or its equivalent. These reserves offer a new and powerful inducement to increased selling and advertising effort even in the face of a possible decline in consumer income.

Taking the Longer View

However, the principal reason why a sales decline was attacked with increased advertising is management's new-found conviction that good advertising is essentially an investment in the development of a market. Successful development requires sustained investment. The inclination of business management to take this longer view, is, of course, motivated by the fact that the American market, with over 3 million consumers being added annually, is growing at a prodigious rate.

Ten years ago only a handful of companies had plans for investment in new producing facilities extending beyond the current year. Today almost all leading companies have investment programs running some years ahead. And keeping pace with these long-range business investment plans has been the development of sales and advertising programs to



Kill a Business Recession

reach tomorrow's greatly expanded markets.

This crucial role of advertising in providing driving power for our economy is gaining greater recognition every day. In his recent book, "People of Plenty," Professor David M. Potter of Yale University remarked: "Advertising is not badly needed in an economy of scarcity, because total demand is usually equal to or in excess of total supply, and every producer can normally sell as much as he produces. It is when potential supply outstrips demand—that is, when abundance prevails—that advertising begins to fulfill a really essential economic function."

Advertising's Key Role

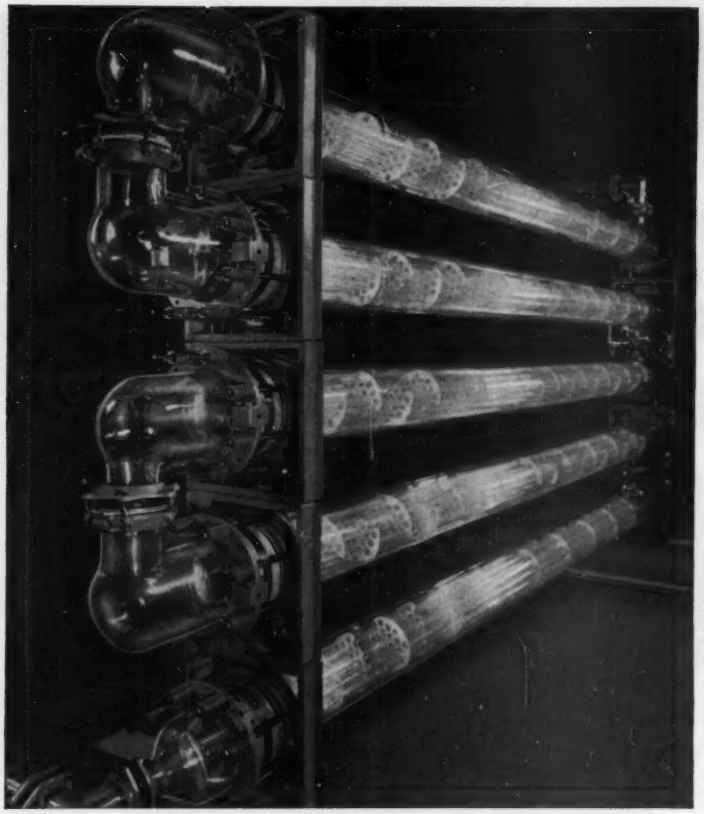
Today abundance so completely prevails in the United States that it has been conservatively estimated that as much as a third of everything offered for sale falls in the realm of "optional consumption." That is, consumers can "take it or leave it" without any immediate personal inconvenience. But if they decide to "leave it," a terrific economic depression will not be far behind. In such circumstances, advertising—in which, in all of its forms, we are now investing about $9.2 billion annually—clearly is of crucial importance to our continued prosperity.

In performing its key role in past years, American advertising never realized its full potential. It successfully promoted sales. But it never was called upon to promote an overall economic stability as a direct outgrowth of increased sales.

By successfully promoting both sales and economic stability, as it did in 1954, advertising surely has added new strength to the American economy. It has also added a great new and constructive dimension to advertising itself. This accomplishment gave great significance to the celebration of the first National Advertising Week in February, 1956.

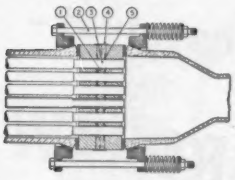
One of the surest means of expanding your sales volume in today's $150 billion *industrial* market is through dominant advertising in the publications directly serving your major customers and prospects.

McGraw-Hill's business and technical publications can give you quick access to the men who initiate, specify and approve the purchases of industrial products and services. Because all are leaders in their respective fields, you are assured a maximum return on your investment when you specify a McGraw-Hill publication to carry your advertising to your most important markets.



Now you can get off-the-shelf delivery on corrosion-proof shell and tube heat exchangers. This new type of unit, low in initial cost, costs nearly nothing to maintain.

Header assembly ends floating head, packing gland troubles



The unique "fluid" seal between the shell side and the tube side is effected by a Silastic sealer sheet (1). This acts as a fluid and is put under fluid pressure by tightening the flange bolts (2). The fluid is completely contained in the cavity formed by the tubes (3) and the retainer ring (4) around the outside of the tube sheets. The Silastic sealer sheet is compressed against the Teflon sealer sheet protector (5), which presses against the precision-finished tube ends, creating a leakproof seal.

Heat, cool and condense corrosive fluids safely in PYREX brand modular shell and tube heat exchangers

Now you can heat, cool and condense corrosives with the same ease you handle noncorrosives.

Because they contact only glass, Teflon and ceramic materials, corrosive fluids can't harm PYREX brand shell and tube heat exchangers. These units are safe, too, for fluids sensitive to metals.

No heat flow barrier

The smooth surface of glass helps keep fluid velocity high. Less stagnant film build up between the fluid and shell on either tube wall. And glass' smooth surface resists scale and algae deposits.

Initial high efficiency stays high permanently.

Wide versatility

The individual shell and tube units are mass-produced standard modules. You circuit the multiples you need in series, parallel or series-parallel flow combinations. You add units as demand increases or cut capacity with external manifolding when demand is down.

Built to bring you savings

Mass production gives you low first cost and off-the-shelf delivery. Installation costs are low because you need only two men and no hoists or cranes. We supply the mounting brackets, the only supporting framework you need.

You get low maintenance costs because there is no corrosion and no scaling. You clean PYREX brand shell and tubes with dilute HCl or even a detergent rinse, without dismantling. The external metal parts are Monel metal or epoxy coated cast iron.

Two models, two sizes

You can choose the new PYREX brand shell and tube heat exchanger in either 50 sq. ft. or 13½ sq. ft. capacities in standard or regenerative types. The standard model takes corrosives on the tube side only. The regenerative takes corrosives on both tube and shell side.

Design Manual tells all

"Design Manual for PYREX brand Modular Shell and Tube Heat Exchanger Units" is a detailed engineering reference guide. It shows you how to select units, lay out systems, engineer systems and order equipment.

Send the coupon for your copy. Or, if you want answers to specific questions, write Plant Equipment Sales Department, Corning Glass Works, Corning, N. Y.

CORNING GLASS WORKS
Corning, New York

Corning means research in Glass

CORNING GLASS WORKS, 15 Crystal Street, Corning, New York

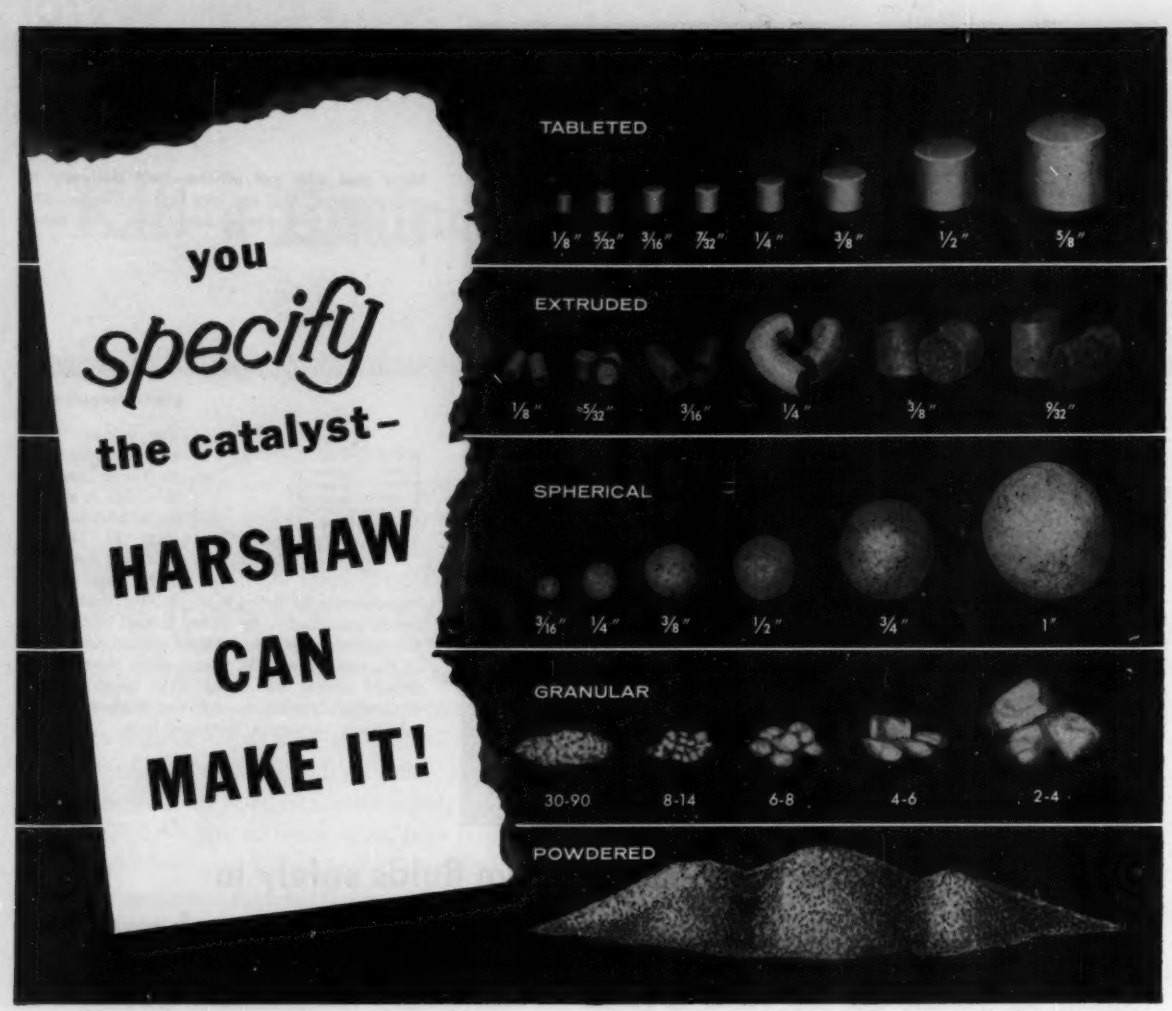
Please send me a copy of your "Design Manual for PYREX brand Modular Shell and Tube Heat Exchanger Units."

Name.....Title.....

Company.....

Street.....

City.....Zone.....State.....



HARSHAW

has the facilities for producing carload quantities of

PREFORMED CATALYSTS

to fit special process requirements

Hydroforming	Dehydration
Cyclization	Desulphurization
Oxidation	Alkylation
Dehydrogenation	Isomerization
Hydrogenation	

CATALYTIC CHEMICALS SUPPLIED BY HARSHAW

Aluminum Nitrate		Cobalt Nitrate
Copper Nitrate		Manganese Nitrate Solution
Metallic Soaps (Cobalt, Manganese)		
Nickel Carbonate	Nickel Formate	Nickel Nitrate
Nickel Sulfate	Sodium Methoxide	Zinc Nitrate

Our experienced technical staff will assist you in developing the best and most economical catalyst. If you have a catalytic process in the development or production stage, a discussion with us may prove beneficial.

Write for FREE Booklet, "HARSHAW CATALYSTS"

HARSHAW

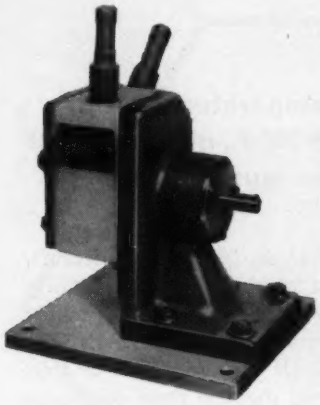
THE HARSHAW CHEMICAL CO.

1945 EAST 97th STREET • CLEVELAND 6, OHIO

Chicago • Cincinnati • Cleveland • Hastings-On-Hudson, N.Y. • Houston • Los Angeles
Detroit • Philadelphia • Pittsburgh

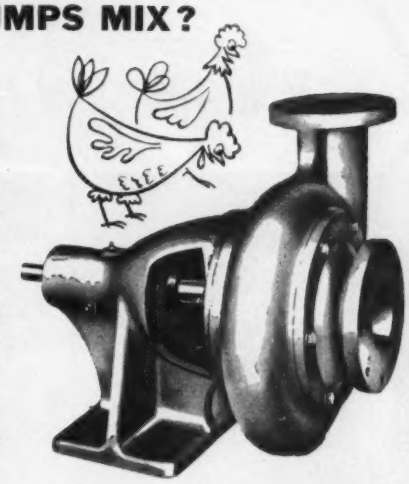
CORPORATION BRIEFS

PUMP ELIMINATES CONTAMINATION

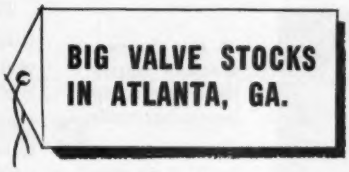


An important manufacturer of radioactive products and specialties had a serious problem in pumping a caustic cadmium ammoniacal solution without metal contamination. Only suitable plastic and synthetic parts could be in contact with this delicate solution. Packing and shaft seals were out. A Vanton (no packing—no seals) B-30 pump with a bakelite body block and a neoprene flex-i-liner was specified. It is still in operation after 2 years of regular service. Costly metal contamination has been eliminated. If your pumping problem calls for "no contamination" call on Vanton for the answer. Catalog 56C available on request.

DO EGGS AND PUMPS MIX?



According to Sinclair-Scott Co., Philadelphia, Pennsylvania, they most certainly do. The sturdy, efficient and dependable centrifugal food pump designed by Sinclair-Scott with Cooper Alloy stainless castings, can even handle raw eggs without damage to their fragile shells. With capacities to 1000 gpm, and heads to 100 ft. the 4" Sinclair-Scott hydro-pump is a natural for handling beans, peas, cut corn, cherries, pickles and a variety of other foods. For a more complete story on design and use of this unusual pump, see the May issue of Cooper Alloy Newscast or write for Bulletin SS56.



Big stocks of Cooper Alloy stainless steel valves and fittings are now being maintained at the Atlanta, Georgia warehouse of Reading, Pratt & Cady. These stocks will back up those already maintained by the various distributors throughout the Southeastern states and act as a reserve to speed deliveries on large or special orders.

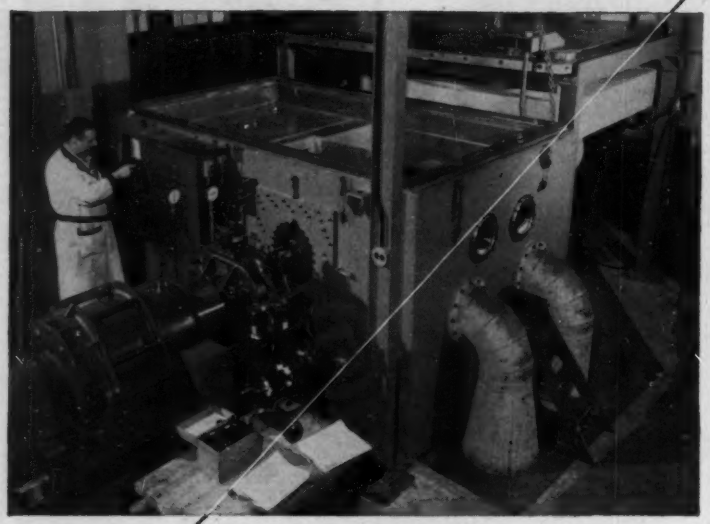
NEW DIVISION SALES MANAGER

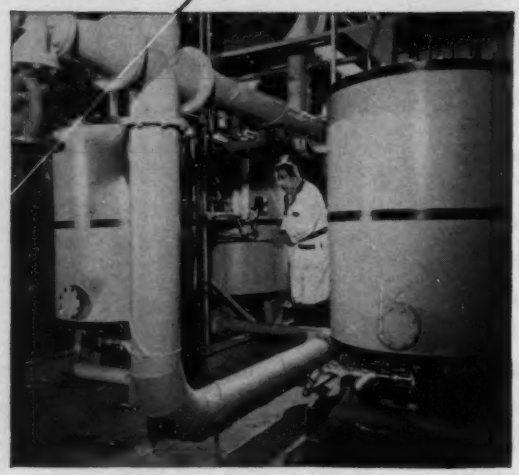
The appointment of Kevney O'Connor, Jr. as Sales Manager of Cooper Alloy's Aircraft Products Division has recently been announced. Mr. O'Connor formerly served as Senior Buyer of aircraft forgings and welding rings with the Jet Division of Thompson Products. He'll be right at home selling the high alloy rings produced by this division of Cooper Alloy by every known method including cast, rolled and welded, and seamless rolled.

COOPER ALLOY
CORPORATION · HILLSIDE, N. J.

Divisions:
FOUNDRY PRODUCTS DIVISION · VALVE & FITTING DIVISION · VANTON PUMP & EQUIPMENT CORP.
STAINLESS ENGINEERING AND MACHINE WORKS DIVISION · AIRCRAFT PRODUCTS DIVISION

Westinghouse altitude chamber simulates flight 23 miles up





▲ *Test chamber, showing motors for driving equipment on test inside.*

◀ *After the two refrigeration units have dropped the dewpoint to 38°, these two Lectrodryers* take it down to −100° F.*

Since temperatures drop below −80° F., air in this test chamber must be DRY

● Electrical equipment for aircraft, product of Westinghouse Electric Corp. at Lima, Ohio, must meet every possible hazard encountered in flight and on the ground. Their laboratory must be able, therefore, to simulate those conditions —even the 80 degrees below zero found 120,000 feet up.

Air at that altitude is DRY, so this Westinghouse laboratory dehumidifies the air blown through this test chamber to a −100° dewpoint. No chance that frost will form and cloud up test results.

For maximum economy in operation, the air is first "rough dried" by a refrigeration unit to 38° dewpoint. Then two BWC-1500 Lectrodryers remove the remaining vaporous moisture to a −100° dewpoint. Tests can be continued day after day, as these driers can be kept on-stream without interruption.

Whether you're DRYing experimentally or on production, there are Lectrodryers to handle the task. For literature on DRYing, write Pittsburgh Lectrodryer Company, 303 32nd Street, Pittsburgh 30, Pennsylvania (a McGraw Electric Company Division).

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S.A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

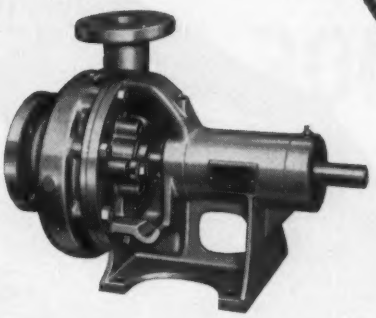
LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

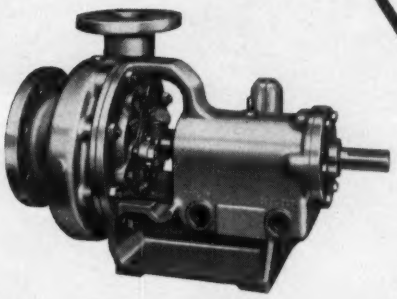
* REGISTERED TRADEMARK U.S. PAT. OFF.

Mr. Engineer: Cut Your Pump Inventory—Reduce Costs With These New, Proved Pumps

PEERLESS CHEMICAL PROCESS PUMPS



type **DL**
grease lubricated housing



type **DM**
oil lubricated housing

Here is
INTERCHANGEABILITY IN ACTION—

Interchangeability of component parts for DL-DM pumps is graphically shown by this slide selector. Write for your FREE copy. It shows how liquid end components are accommodated on either grease lubricated or oil lubricated bearing housings. Also provides quick reference to pump specifications and performance characteristics.

a new concept of economy through interchangeability of components!

PEERLESS

type DL & DM PROCESS PUMPS ALSO FEATURE:

ACCESSIBILITY—Through ease of assembly and disassembly if and when required. **DURABILITY**—Through use of any machinable metal as materials of construction. **SERVICEABILITY**—Through designs that feature maximum ease of maintenance. **INTERCHANGEABILITY**—Through a choice of semi-open or enclosed impellers, oil or grease lubrication, air-or water-cooled back plates and bearing housings. **RELIABILITY**—Through the high performance standards set for these pumps, proving more than ever before, that Peerless Builds Dependable Pumps. **AVAILABILITY**—Through shipment from stock of both complete pumps and pump components.

Other pertinent Type DL-Type DM facts:

Peerless Type DL and Type DM process pumps are available in 1", 2", 2½" and 3" sizes on an 8½" frame and in 1", 2", 2½", 3" and 4" sizes on a 10½" frame. **CAPACITIES:** up to 800 gpm. **HEAD RANGE:** up to 430 feet. **DRIVES:** motor or steam turbine. **TEMPERATURE RANGE:** grease lubricated housing up to 250°F.; oil lubricated housing up to 450°F. **WORKING PRESSURES:** up to 400 psig.

Write for your Slide Selector now. Use coupon for quick action.

PEERLESS PUMP

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION

Factories: Indianapolis 8, Indiana and Los Angeles 31, California
Offices: New York, Chicago, St. Louis, Atlanta, Lubbock and Plainview, Texas; Fresno, Los Angeles, Phoenix, Albuquerque.
Distributors in Principal Cities. Consult your local Telephone Directory.

fmc FOOD MACHINERY AND CHEMICAL CORPORATION

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, California

Please send chemical process pump selector DR-1

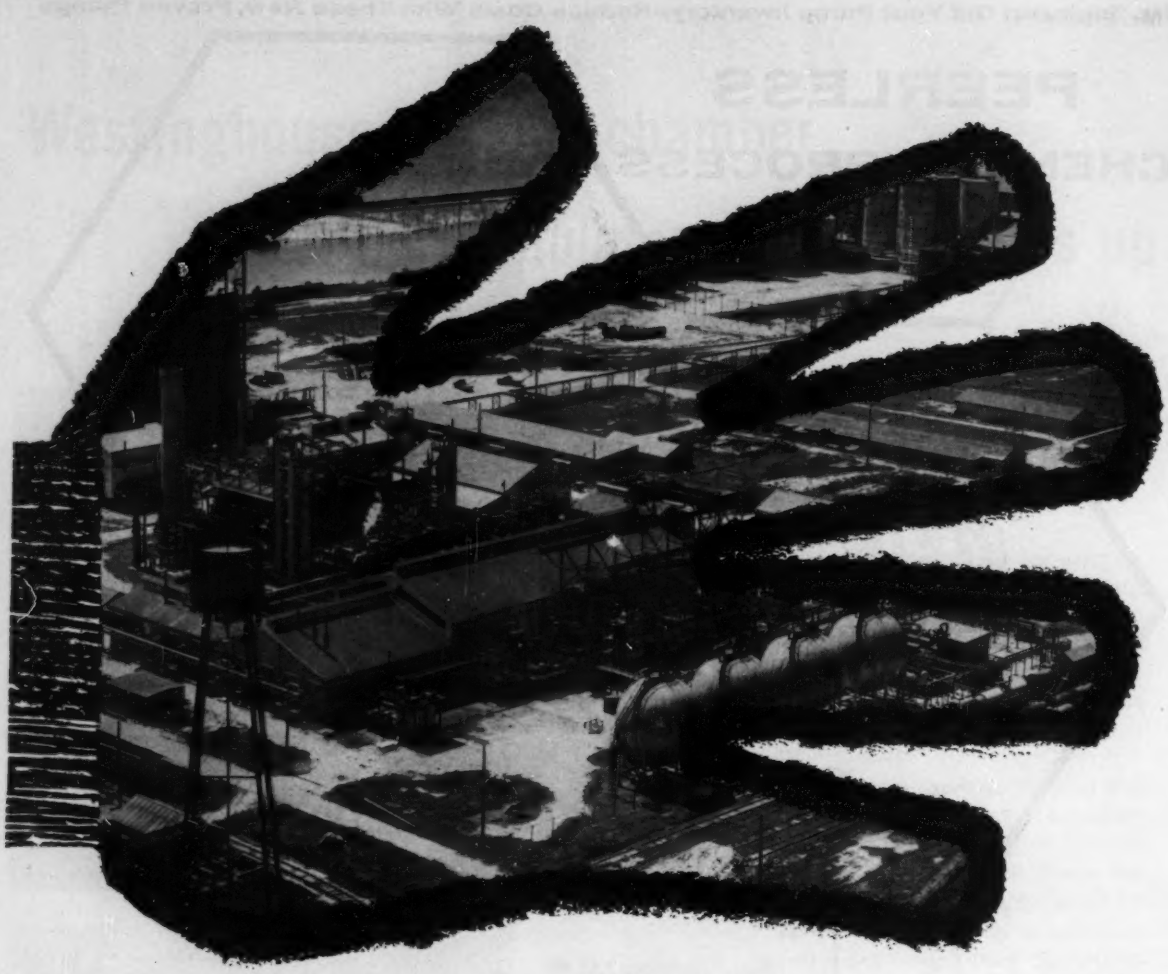
Name_____

Company_____

Address_____

City_____ State_____

CE



Handling Caustics and Alkalis?
Prevent Contamination with

ALCOPLATE*

A chemically deposited nickel plate

In applications where caustics and alkalis are handled, they can be protected with ALCOPLATE against contamination from pipe, valves, pumps and vessels. ALCOPLATE reduces the danger of iron pickup to a minimum, and also resists corrosion of process equipment.

ALCOPLATE can be applied to parts with intricate shapes. It provides a continuous non-porous plating of uniform thickness and eliminates the need for expensive machining of costly metals. Hardness is 45 Rockwell C and can be increased to 70 Rockwell C through post-plate heat treatment. Corrosion resistance? In nearly all applications, ALCOPLATE is equal to or better than pure or wrought nickel.

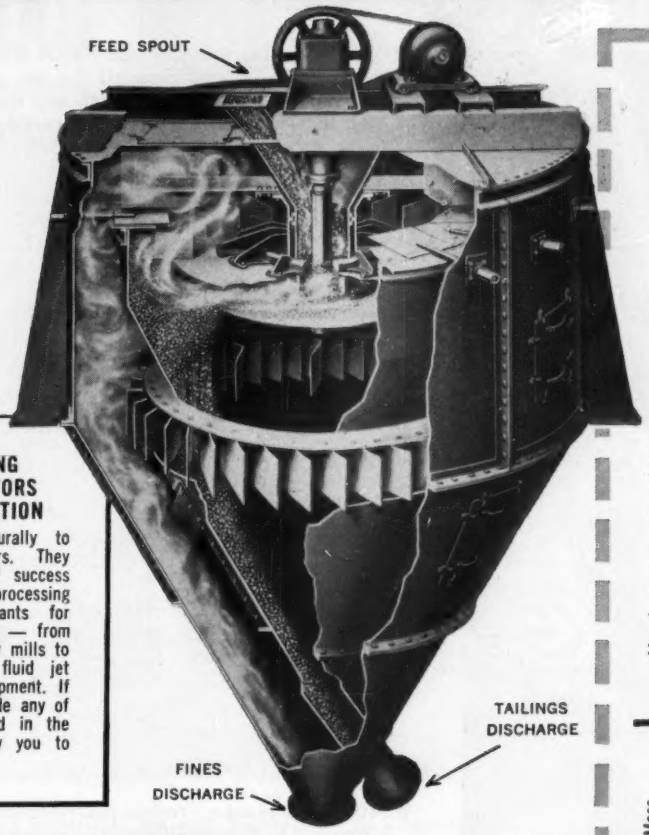
To prevent contamination and insure long life for your process equipment, call your nearest Alco representative. He has complete information on ALCOPLATE performance in specific services. Or write P.O. Box 1065, Schenectady 1, N. Y.

*ALCOPLATE – Trade-mark registration applied for. An application of "Kanigen" a mark identifying the chemical deposition of high-nickel, low-phosphorus alloy by General American Transportation Corporation and its licensees and the coating resulting therefrom – on license from General American Transportation Corporation.

ALCO

ALCO PRODUCTS, INC.,
New York

40 TO 400 MESH OUTPUT UPPED AS MUCH AS 300%



ENGINEERING AIR SEPARATORS TO SPECIFICATION

. . . comes naturally to Sturtevant engineers. They have a tradition of success in developing dry-processing equipment and plants for more than 75 years — from the first rock emery mills to the most modern fluid jet micron-grinding equipment. If your problems include any of the processes listed in the coupon, it will pay you to investigate.

WHAT CAN A STURTEVANT AIR SEPARATOR DO IN YOUR PULVERIZING SYSTEM?

In the cement industry, Sturtevant Air Separators have a tested record of increasing mill capacities from 25 to 300% while lowering power consumption as much as 50% — when used in closed circuit with grinding mills. Maybe they can do as well for you.

Easily adaptable to your materials. Sizes of Sturtevant Air Separators range from 3 to 18 feet in diameter. They deliver fines from 40 to 400 mesh at rates as high as 100 tons per hour.

Designed to cut costs! Sturtevant Air Separators are built for a lifetime of low-downtime service. Rugged construction plus easy accessibility for quick maintenance (typified by the "OPEN-DOOR" design in other Sturtevant equipment) assures more output per machine-year. Check the coupon for more information.

STURTEVANT

Dry Processing Equipment

The "OPEN-DOOR" to *lower* operating costs over *more* years

CRUSHERS • GRINDERS • MICRON-GRINDERS • SEPARATORS
BLENDERS • GRANULATORS • CONVEYORS • ELEVATORS

My dry-process materials are:_____

Desired capacity is:_____

Name_____ Title_____

Firm_____

Street_____

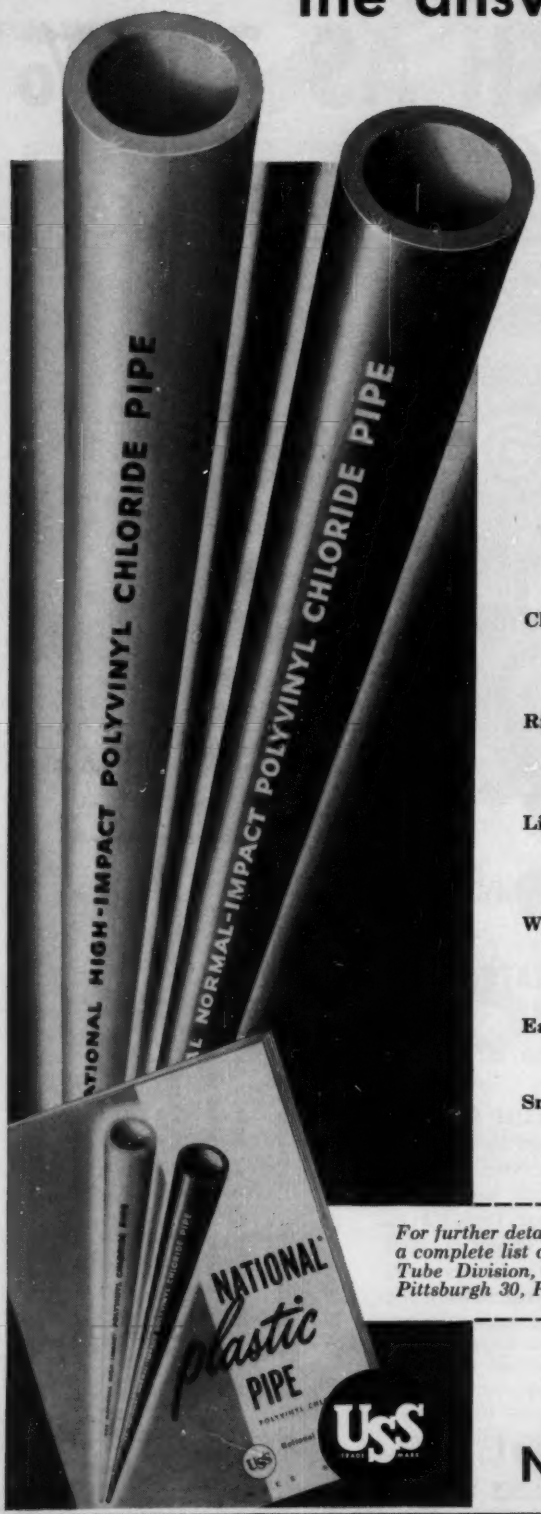
City_____ Zone_____ State_____

STURTEVANT MILL COMPANY, 100 Clayton Street, Boston 22, Mass.

Please send me your bulletin on Air Separators ☐
Also bulletins on machines for:

☐ CRUSHING ☐ GRINDING ☐ PULVERIZING
☐ MICRON-GRINDING ☐ SEPARATING ☐ BLENDING
☐ SUPERFINE SELECTING ☐ GRANULATING ☐ CONVEYING

Is USS NATIONAL* PVC PLASTIC PIPE the answer to your corrosion problems?



The chemical industry has solved a wide variety of plant corrosion problems through the use of polyvinyl chloride plastic pipe. This pipe—specifically designed to do a *better* job than any other material for certain tasks—possesses not only excellent chemical resistance but remarkable physical properties.

Two types of extruded National Polyvinyl Chloride Plastic Pipe are available. Sizes run from ½" to 6" dia. inclusive, in Schedules 40 and 80. NORMAL-IMPACT is designed for installations requiring the highest chemical resistance attainable, together with high strength and excellent creep resistance. HIGH-IMPACT is designed for installations requiring excellent chemical resistance and a high degree of toughness, even at low temperatures.

The following properties are found in both Normal- and High-Impact National PVC Plastic Pipe:

Chemical Resistance—resists attack by acids, alkalies, salt solutions, and alcohols, as well as many other types of chemicals. Nontoxic. Will not impart taste or odor to liquids.

Rigidity—permits use in overhead piping installations with pipe supports. Schedule 80 pipe may be threaded with steel threading dies.

Lightweight—twenty feet of 2-inch Schedule 40 pipe weighs less than 13 pounds. Easy to install in cramped space and hard-to-reach places.

Weather Resistance—resists deterioration due to aging when exposed to direct sunlight. Also resists fungi, bacterial action and soils.

Ease of Installation—fittings readily attached by either solvent cementing, threading, heat welding, or adhesives.

Smooth Internal Surface—results in low flow resistance, minimizes the build-up of deposits.

For further details on USS National Polyvinyl Chloride Plastic Pipe, including a complete list of chemical resistances, send for Bulletin 24. Write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

*Trademark

NATIONAL plastic PIPE

UNITED STATES STEEL

At the Baton Rouge Plant of Kaiser Aluminum & Chemical Corporation

Stay-dry FOAMGLAS insulation beats humidity, prevents corrosion on process tanks and vessels

Four years ago FOAMGLAS was installed on various process tanks and vessels at Kaiser Aluminum & Chemical Corporation's Baton Rouge, Louisiana plant. They needed a moisture resistant insulating material which could withstand high and rapidly changing humidity.

Because FOAMGLAS *stays dry* it was installed on hot water tanks and sodium aluminate process vessels varying in capacity from 2000 to 400,000 gallons. The moisture-proof structure of FOAMGLAS is giving *constant insulating protection* and is effectively preventing corrosion . . . despite the severe humidity conditions. Because it's fireproof FOAMGLAS is also providing an added safety factor.

These benefits and more can be *yours* when you insulate vessels, piping, equipment or buildings with long-lasting, *stay-dry* FOAMGLAS. Write for full details. We'll be happy to send you a free sample and our latest literature pertinent to your needs.

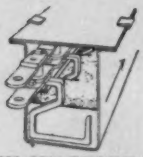
Pittsburgh Corning Corporation
Department H-76, One Gateway Center
Pittsburgh 22, Pennsylvania
In Canada: 57 Bloor St. W., Toronto, Ontario

Also manufacturers of PC Glass Blocks

You can easily prove that FOAMGLAS stays dry by making this simple test. It and five other equally simple tests will quickly demonstrate the combination of properties that make FOAMGLAS the perfect solution to your insulating problems. Write now for a free sample and complete testing directions.

BELT CONVEYORS

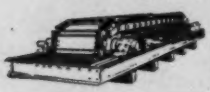
VIBRATING CONVEYORS



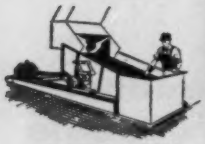
REDLER CONVEYOR-ELEVATOR

ZIPPER CONVEYOR-ELEVATORS

BUCKET ELEVATORS

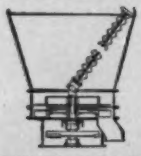


PAN CONVEYORS



VIBRATING SCREENS

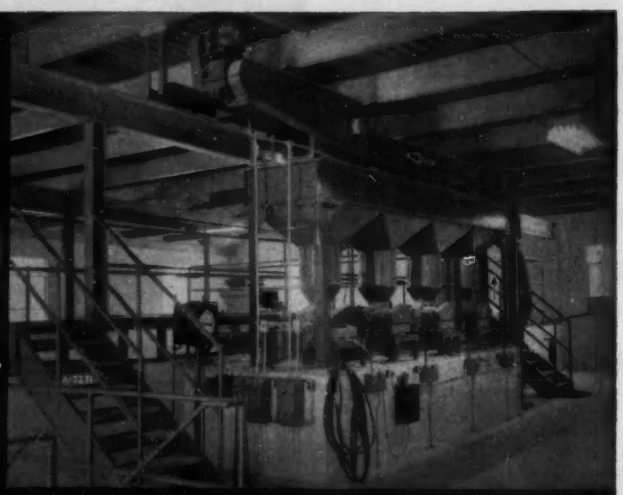
BIN GATES—ALL KINDS



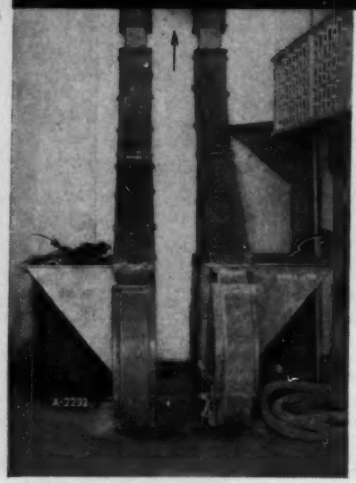
CIRCULAR BIN DISCHARGERS

SEALMASTER BALL BEARING UNITS

LIME and SODA ASH ON THE DOUBLE!



S-A REDLER CONVEYOR ELEVATOR SYSTEM provides water treatment for Village of Clyde

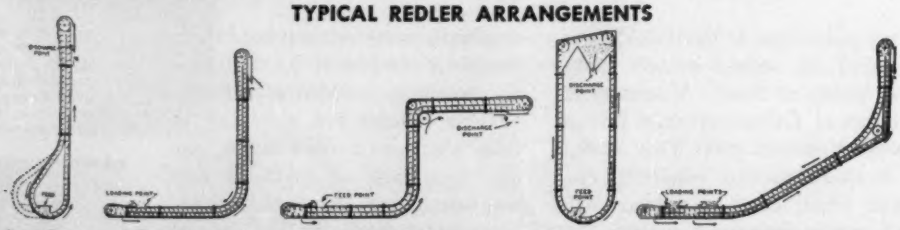


The municipal water treatment plant at the Village of Clyde, Ohio, contains twin S-A Redler loop boot vertical and horizontal conveyors for delivery of hydrated lime and soda ash.

Inherently economical, this type Redler requires no boot pit since loading point is only slightly above floor level. Furthermore, no special feeding apparatus is needed. Bulk materials which have a tendency to aerate are fed to the return side of conveyor loop. A seal in the load is thereby created, permitting material to move smoothly and in a solid column to point of discharge. Minimum space requirements for this S-A system is an important factor in small plant installation.

As was true at Clyde, simple adaptations of standard S-A conveyor products very often provide extremely low cost and efficient bulk material handling. In fact, Stephens-Adamson's wide product range and versatility can often provide a conveying system that is virtually "in stock."

TYPICAL REDLER ARRANGEMENTS



Loop Boot Elevators | L-Type Elevator-Conveyor | Z-Type Elevator-Conveyor | Vertical Closed Circuit Elevator | Special Elevator-Conveyor

FREE BULLETINS AVAILABLE ON ALL THESE PRODUCTS

STEPHENS-ADAMSON MFG. CO.

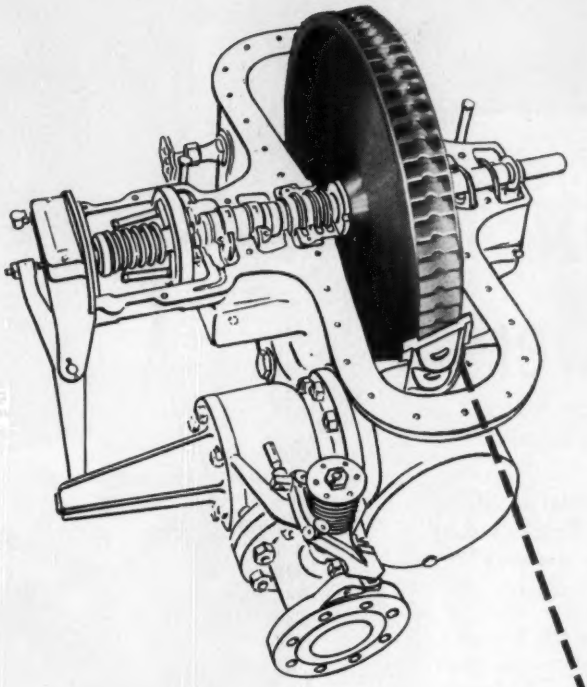
3 Ridgeway Ave., Aurora, Ill.—Los Angeles, Calif.—Belleville, Ontario.

ENGINEERING DIVISION
Designers and manufacturers of all types of bulk materials conveying systems.

STANDARD PRODUCTS DIVISION
A complete line of conveyor accessories—centrifugal loaders—car pullers—bin level controls, etc.

SEALMASTER DIVISION
A full line of industrial ball bearing units available in both standard and special housings.

Work Horse of Industry..since 1906



The Terry Steam Turbine Company was incorporated in 1906 to manufacture *a workable and efficient prime mover that would operate with minimum maintenance.* This prime mover was the solid-wheel turbine, which had been invented by Edward Clinton Terry a few years before.

Although maintenance practice has improved vastly since then, the demand for the turbine has multiplied many times. *Rising maintenance costs have actually increased the need for trouble-free operation.*

Today, there are more Terry solid-wheel turbines in operation, and there are more built each year, than ever before. The explanation is simple.

Here is a turbine with a virtually indestructible wheel. Made of a single forging of special composition steel, there are no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which may occur does not materially affect horsepower or efficiency.

Blades will not foul. They have large clearances and are further protected by the projecting rims at the sides of the wheel. As the side clearances are also very large, end play can do no harm.

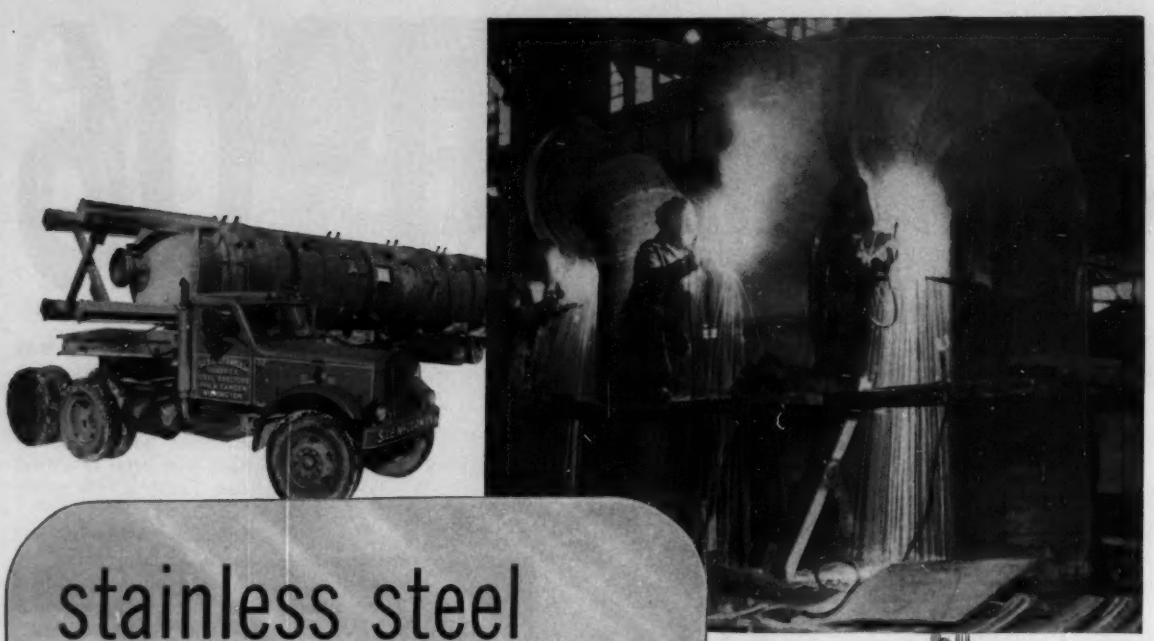
These are a few of the reasons why the Terry solid wheel turbine has been the *work horse of industry – since 1906.* For the full story, send for a copy of Bulletin S-116.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

1906 was the year this turbine was built in Terry's plant. It is believed to be one of the first small direct-connected turbines built for commercial use in the United States.

TT-1203



stainless steel holds the answers

Every industry that works with steel has its special problems of the proper steels for every job . . . more and more industries are finding that Stainless "holds the answers" to their problems.

Take the petroleum and chemical industries for instance. They demand resistance to corrosion, to abrasion, high temperatures, cold temperatures, scaling and hydrogen blistering. Solid stainless can do the job. But, in some equipment, stainless cladding can answer the problems . . . and cut costs as well.

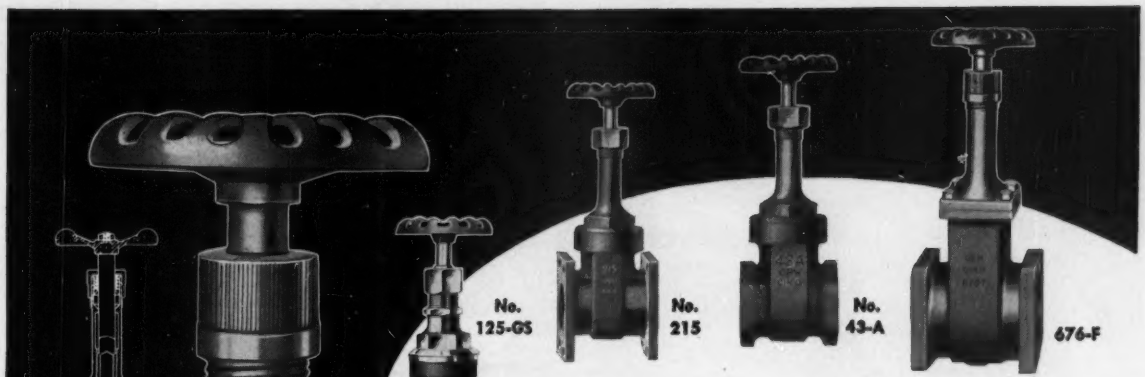
Sun Ship knows how to fabricate stainless and the other special alloys. They have the facilities and experience. Large jobs or small jobs will receive prompt attention.

Our Sales Engineering Department will be glad to discuss with you any problems to which our Alloy Products Shop may hold the efficient and economical answer.

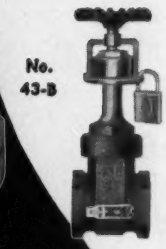
ALLOY PRODUCTS SHOP

OF Sun SHIPBUILDING & DRY DOCK COMPANY

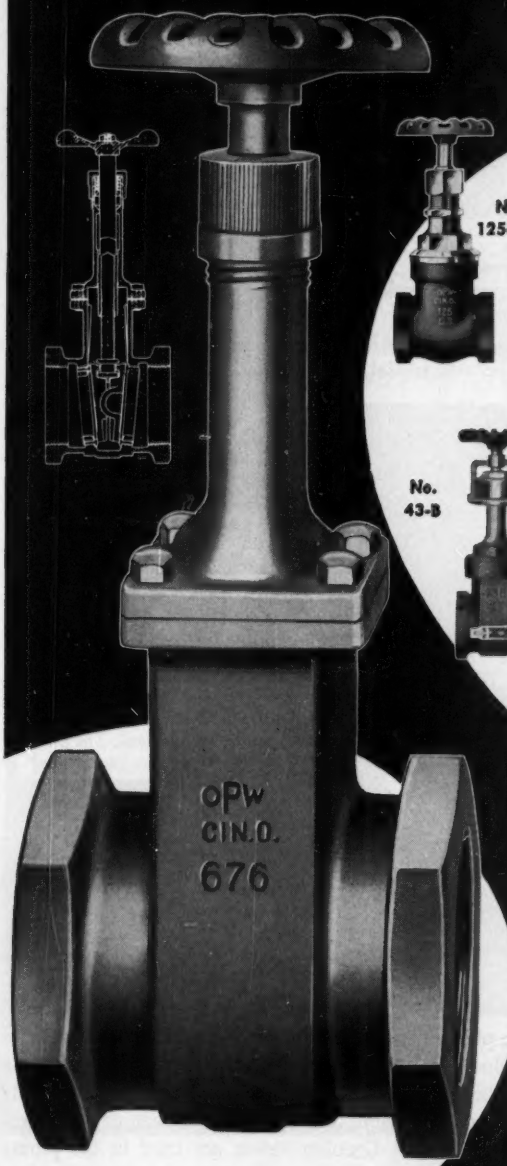
ON THE DELAWARE • CHESTER, PA. • 25 BROADWAY, NEW YORK CITY



REDUCE YOUR "DOWN-TIME"



WITH OPW valves



No. 676

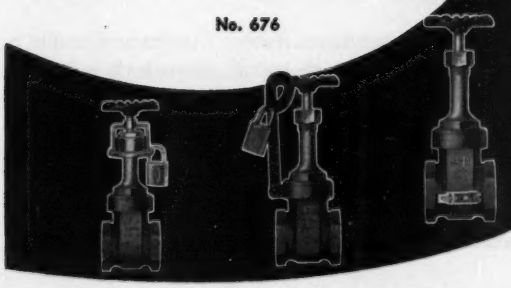
"Down-time" frequency for valve repair is appreciably lessened with OPW Valves specifically engineered for hazardous liquid service. They are ground tighter, engineered with larger stuffing boxes, machined to closer tolerances, and produced of the finest grades of bronze and aluminum. Highest possible quality is reflected in the dependability, ruggedness and precise flow control of all OPW Valves.

Recognizing the need and answering the demand for a valve which would reduce the tare weight of truck tanks without sacrificing peak efficiency, OPW has developed the lightweight 676. After exhaustive tests, it has been added to the complete family of OPW Valves.

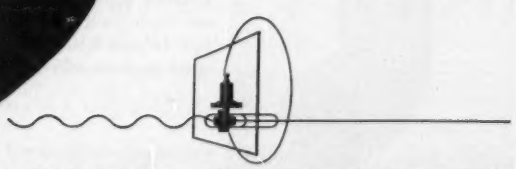
CHARACTERISTICS OF THE 676 VALVE

Flanged or screw body and bolted bonnet of OPALUMIN, as strong as bronze, one third the weight. Interior parts of precision machined bronze. Ball and socket double discs, self aligning, tapered design seating against hand lapped renewable bronze seat rings for a sure, vapor-tight, no-leak closure. *Renewable seat rings are threaded and seated against shoulder,* so despite contraction and expansion of the body, the threaded ring remains seated. Compound double acting threads allow closer clearance when valve is opened, require fewer turns to open and close. Strong, large diameter stems do not bend.

Available in 3" size.



GATE VALVES • EMERGENCY VALVES • CROSS CHECK VALVES • CROSS VALVES • CHECK VALVES • GLOBE VALVES • PRESSURE RELIEF VALVES • COMPRESSION CHECK VALVES • LOADING VALVES

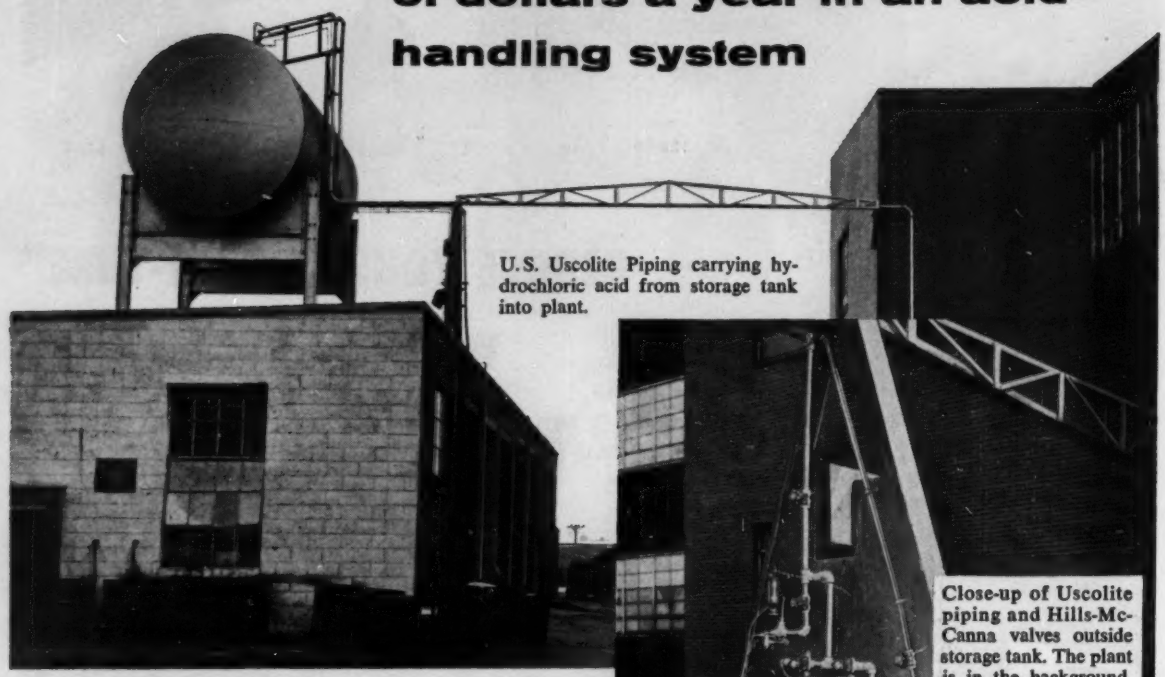


JORDAN CORPORATION

INDUSTRIAL SALES DIVISION OF OPW CORPORATION

6013 WIEHE ROAD CINCINNATI 13, OHIO

Uscolite Pipe helps save thousands of dollars a year in an acid-handling system



U.S. Uscolite Piping carrying hydrochloric acid from storage tank into plant.

Close-up of Uscolite piping and Hills-McCanna valves outside storage tank. The plant is in the background.

A large Eastern manufacturer of lighting and signaling systems uses 300 feet of Uscolite® plastic pipe to carry hydrochloric acid from storage tanks outside the plant across an areaway, and then through various production departments to final use in the plating room. Previously, carboys of acid had been used, because the plant had no facilities to store acid in bulk. But by installing a new acid-handling system, using U.S. Uscolite piping and fittings, the plant saves thousands of dollars a year—they now *buy and store in bulk*. Additional thousands are saved by reduced handling costs.

Uscolite pipe and fittings are made in the broadest and largest line of stock sizes on the market.

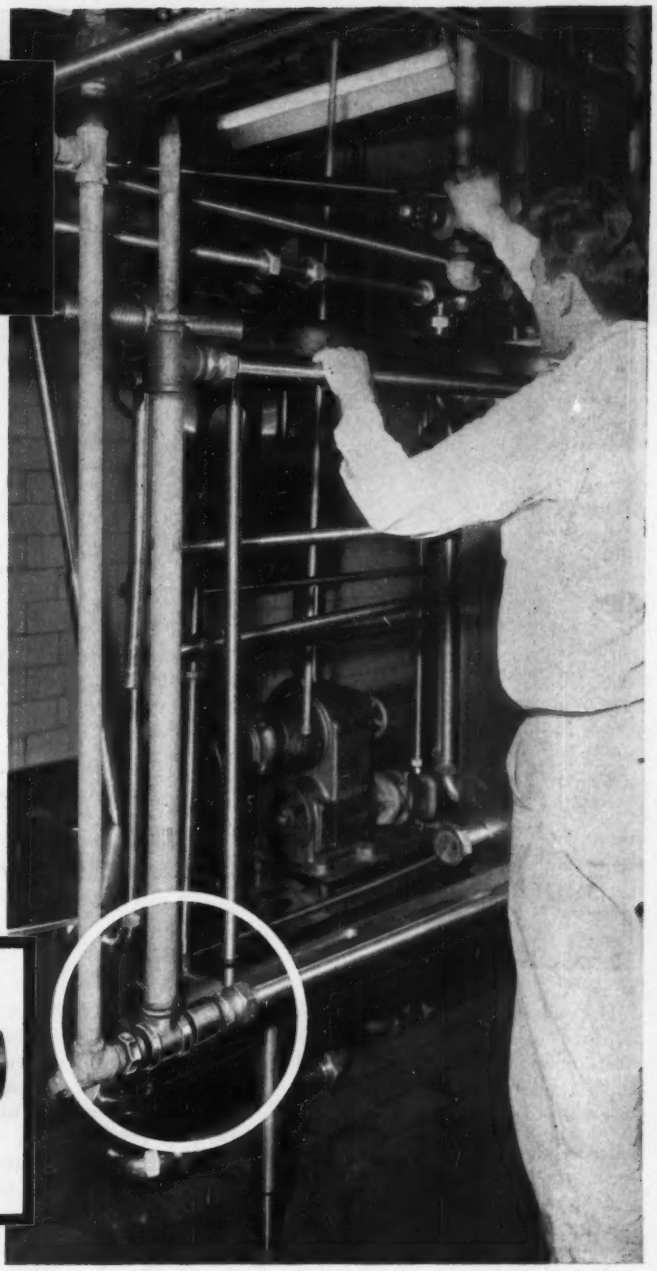
The plant engineer is pleased because Uscolite's unusual mechanical strength enables it to be left exposed in any weather, and to be run overhead through various parts of the plant without fear of damage to men or machines. Hills-McCanna Uscolite valves are used in the piping assembly.

Made by United States Rubber Company, Uscolite is light in weight with high impact strength. It is solving acid and corrosion problems in every industry. The piping can be easily threaded and installed with conventional tools. For replacements or a completely new piping system, get in touch with any of our 28 strategically located District Sales Offices, or contact us at Rockefeller Center, New York 20, N. Y.

Mechanical Goods Division

United States Rubber

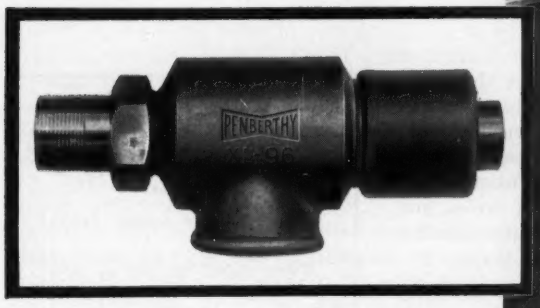
DeLaval...
"puts the pump in a pipe"



Does the PENBERTHY EJECTOR *in this installation suggest uses to you?*

Sometimes you can get a good idea for your own business by seeing what the other guy is doing. Here's a case in point...

DeLaval of Poughkeepsie, N. Y. is a big name in dairy equipment, known for their engineering ability. This is one of their installations. It's a heat exchanger used in connection with a separator at the Bodker Dairy in Detroit. In it they use a Penberthy steam operated ejector as an effective means of heating and circulating water. This simple device eliminates entirely the need for a motor operated circulating pump. In addition to a lower original cost, further advantages are realized in maintenance and operation.



Penberthy Ejectors are steam, air and liquid operated for liquid transfer, heating, circulating, aerating, agitating, mixing, pumping, bleeding and exhausting air or vapor and producing high vacuum. They are trouble-free with no moving parts to get out of order. They are available in bronze, iron, stainless steel, plastic and other materials. Standard and custom-made designs. It will pay you to get the complete facts. Simply write for Catalog 512R.

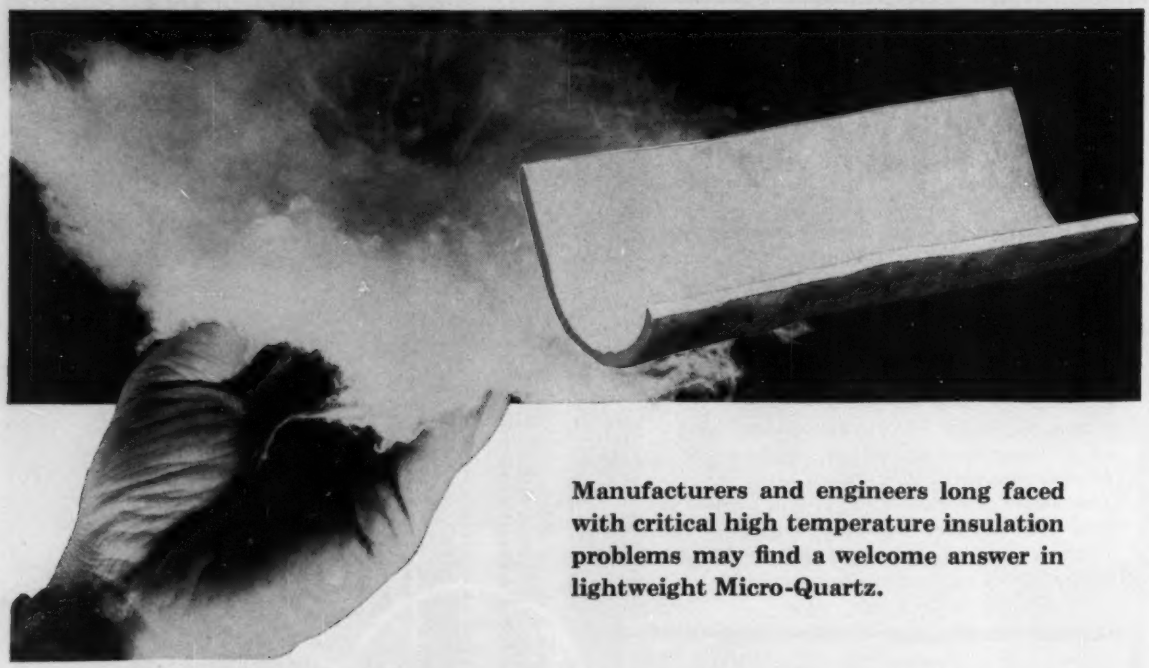
PENBERTHY INJECTOR COMPANY *Division of Buffalo-Eclipse Corporation*
1242 Holden Avenue Detroit 2, Michigan

***There's Certain satisfaction in* PRODUCTS BY PENBERTHY**

- EJECTORS
- INJECTORS
- CYCLING JET PUMPS
- ELECTRIC SUMP PUMPS
- LIQUID LEVEL GAGES
- GAGE VALVES

L·O·F Glass Fibers Company Introduces

MICRO-QUARTZ—The new insulation for the 2000°-2500° Temperature Range!



Manufacturers and engineers long faced with critical high temperature insulation problems may find a welcome answer in lightweight Micro-Quartz.

L·O·F Glass Fibers Company announces Micro-Quartz—a remarkable, new insulation for temperatures ranging, under many conditions, up to 2500°!

Micro-Quartz is available in felted form and in bulk. It is light in weight and composed of 98% pure quartz. It is resilient, exceptionally efficient, and resistant to vibration and air flow. Because it has no organic binder, its performance, stability, and thermal conductivity are those of the quartz fibers themselves.

The range of uses to which Micro-Quartz can be put is very broad, with possible applications in all industries doing work in the high-temperature field. It may be the answer to high temperature problems involving low heat capacity and high thermal diffusivity, frequent- or rapid-heating cycles, and problems of weight, space limitations, and vibration.

Micro-Quartz fibers are available in paper form. Can be impregnated or coated for electrical applications.

Requests on your business letterhead for more information, and a Micro-Quartz sample, will receive prompt attention. Write: L·O·F Glass Fibers Company, Dept. 88-56, 1810 Madison Ave., Toledo 1, Ohio.

PRODUCT DATA ON STANDARD MICRO-QUARTZ SHEETS*

Average Fiber Diameter—0.75 microns or 0.00003 inches

Density—Standard nominal density is 3 lbs./cu. ft.

Weight—0.047 lbs. per sq. ft.—0.005 lbs.

Thickness of sheet—Standard nominal thickness is 3/16 inches

Width of sheet—34 inches

Length of sheet—71 inches

*Other thicknesses and densities are available. Sheets can be fabricated to fit your application.

L·O·F GLASS FIBERS Micro-Quartz HIGH TEMPERATURE INSULATION

L·O·F GLASS FIBERS COMPANY

TOLEDO 1, OHIO

Makers of glass fibers by the exclusive "Electronic-Extrusion" process

Inco high temperature research note:

Carburization

...and its effects on metals at high temperatures

With sufficient background of information on the strength properties and corrosion characteristics, it should be entirely possible to predict the performance of an alloy under any conditions of high temperature service.

Method of Obtaining Data

Data relating to the mechanical properties may be obtained in the laboratory by any of the conventional testing methods . . . on the other hand, the problem of high temperature corrosion resistance is often so complex that it is frequently more convenient to place test specimens in an actual service environment than to try simulating industrial conditions on a laboratory scale.

This course is being pursued by Inco's high temperature engineers working in the field and in laboratories at Bayonne, N. J. and Huntington, W. Va. Creep and rupture tests at temperatures as high as 2100°F have supplied data on the strength properties of high nickel alloys. Corrosive attack by various hot atmospheres, fused salts and molten metals is being studied principally in the field to provide the type of information that will assist industry to select more suitable, longer lasting materials for various high temperature applications.

Effects of Carburization

Carburization—as may result from contact with carbonaceous atmospheres in petro-chemical or petroleum refining operations or during the heat treatment of steel parts—is one type of high temperature reaction which, under certain conditions, can change the properties of heat resistant alloys and adversely affect their performance.

Carbon diffuses into the metal and subsequently precipitates as a carbide particle rich in chromium. Compared to the alloy matrix, the carbide phase is hard and brittle. If distributed throughout grain boundaries, the particles provide a continuous path for brittle failure. (See micrograph below.) In certain types of service, carburization of a heat-resisting alloy may not be a serious matter. But in the usual case where the metal part or structure may be called upon to exhibit some measure of ductility or be subjected to impact or to drastic temperature changes, carburization often leads to premature failure.

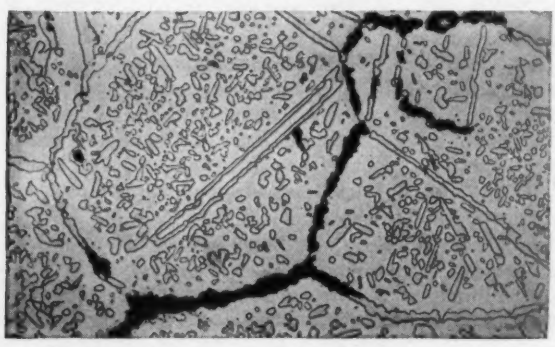
Nickel Plays Basic Role

In general terms, the susceptibility of iron-chromium-nickel alloys to carburization seems to depend upon the relative amounts of the individual components – but not as one might expect. Iron and chromium form stable carbides, while nickel does not. Yet Inco test data show that chromium has a greater effect than either iron or nickel. But it has also been demonstrated that for a given amount of chromium its beneficial effect is much greater at a higher nickel level than at a lower. Conversely, for given nickel content it would be expected that an alloy containing a higher chromium content would be more resistant to carburization.

Assistance Available

Inco high temperature corrosion test data also suggest that silicon improves carburization resistance, as does the presence of carbide stabilizing elements, such as titanium and columbium. Under extremely severe conditions of carburization, the effect of these elements is but temporary, and after sufficiently long exposure, their value is lost.

In a fast growing field such as this, it is impossible to have an immediate answer to every problem. But if high temperature performance is a problem to you, whether in present activities or in new projects, Inco High Temperature Engineers will do their best to help you. Let them send you the High Temperature Work Sheet . . . it is a big aid in getting the facts down clearly. Send for a copy now.



INCO
TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Please send me the High Temperature Work Sheet so that I may outline my problem to you.

Name_____

Title_____

Company_____

Address_____

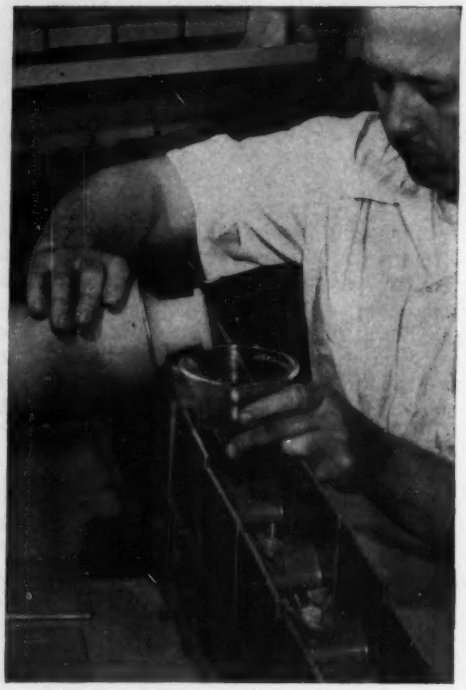
City_____ State_____

UNICHROME
Trade Mark

News about
COATINGS for METALS
Metallic ..... Organic ..... Decorative ..... Protective

Finding the right chemical resistant linings to protect drums

Chemical Engineers can help solve packaging problems through the work of Metal & Thermit



By such simple yet reliable means as test cells, resistance of *various* drum lining formulations to any one specific product is readily determined. Similarly, resistances of one particular lining to a whole range of chemicals is just as easily gauged.

THE AIMS

Metal & Thermit makes such tests by the hundreds of cells. This effort is aimed at improving existing coatings for drum lining service; at sizing up the worth of newly developed coating materials; at helping processors find the one best lining for a particular product to be packaged, shipped or stored in drums.

Coatings meeting chemical resistance requirements are double-checked for impact resistance, adhesion, film continuity and thickness, distensibility, and flexibility.

THE FINDINGS

This work has produced reliable and valuable information. With just four basic coating types, a tremendous variety of products and chemicals can be handled in metal containers. These four include a Unichrome vinyl, phenolic, epoxy and plastisol series of drum linings.

Results in service bear out test cell findings. Unichrome Drum Linings are being specified for such products as acids, alkalies, salts, alcohols, wetting agents and detergents, and many, many others. Drum corrosion and product contamination have been avoided. Shipping costs have been cut.

For important application data and typical usages of these Unichrome Drum Linings, send for Bulletin DL-2.

Plastisol permits spraying of sheet-like coatings

A plastisol developed especially for spraying, Unichrome Coating 5300 applies easily to the exterior of tanks and ducts, and as a lining for equipment. It produces protective films up to 20 mils thick with one coat. Multiple coats can therefore provide thickness equivalent to plastic and rubber sheet materials generally used for protection. Plastisol does a superior job since there are no seams or joints.

Coating 5300 bakes at 350° to 365°F, won't chip, and withstands a wide range of corrosive materials. A number of firms are available that can apply Coating 5300 for any plant without the required baking facilities.

Bulletin VP-1 gives more data on Unichrome Plastisols.

Neoprene for heavy-build maintenance coatings

Several new Ucilon* Coating Systems give chemical engineers unusually effective weapons against corrosion. These systems are based on neoprene coatings for air dry or force dry application. Chief physical characteristic of these systems is the substantial build-up of coating to resist severe service conditions. *Send for details*

(* Trade Mark)

METAL & THERMIT
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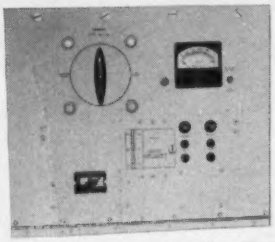
New Standard
STABILINES

Meet Conditions Usually Considered as Special Applications

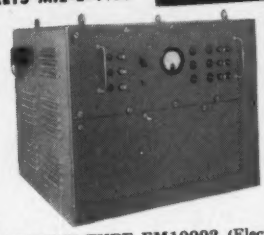
The "Unusual" is Usual for STABILINE* Automatic Voltage Regulators

DESIGNED FOR MIL-E-16400



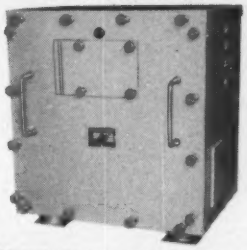
STABILINE TYPE EM10004 (Electro-mechanical)
INPUT: 195-255 volts, 50/60 cycles, single phase
OUTPUT: 230 volts, 24 KVA

MEETS MIL-E-4158



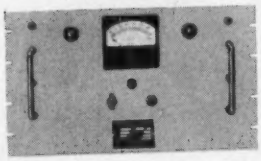
STABILINE TYPE EM10002 (Electro-mechanical) for Air Force land based installations.
INPUT: 105-135 volts, 55/65 cycles, three phase, 4 wire
OUTPUT: 120 volts phase to neutral, 55.5 amperes, 20 KVA, individual phase control

U. S. NAVY SPECIFICATIONS 16-E-4 AND 40-T-9



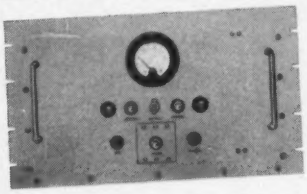
STABILINE TYPE EM10006 (Electro-mechanical) for applications involving shock and vibration requirements.
INPUT: 385-490 volts, 45/65 cycles, single phase
OUTPUT: 440 volts, 2.2 KVA

FOR NORMALLY LOW INPUT VOLTAGES



STABILINE TYPE EM10003 (Electro-mechanical)
INPUT: 80-115 volts, 50/60 cycles, single phase
OUTPUT: 115 volts, 2.0 KVA

MEETS SPECIFICATION MIL-E-4158

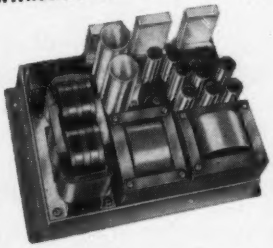


STABILINE TYPE EM10009 (Electro-mechanical)
INPUT: 187-229 volts, 410 cycles ±5%, three phase, 4 wire
OUTPUT: 203-213 volts, 14.0 amperes, 5.0 KVA

FOR MILITARY APPLICATIONS

STABILINE TYPE IE20003 (Completely Electronic) with no moving parts.
INPUT: 95-135 volts, 60 cycles ±10%, single phase
OUTPUT: 115 volts nominal, adjustable 110-120 volts, 8.5 amperes, 1.0 KVA

WITHSTANDS HIGH HUMIDITY



STABILINE TYPE IE20002 (Completely Electronic) with no moving parts.
INPUT: 190-250 volts, 50/60 cycles, single phase
OUTPUT: 230 volts, 150 VA

Check the characteristics of these new STABILINE Automatic Voltage Regulators against your "special" requirements involving automatic voltage regulation. You may find that you no longer need to look for special equipment. These units are standard STABILINES as are numerous other units with rated capacities from 0.25 KVA to 100 KVA. Look to SUPERIOR ELECTRIC for the solution to your automatic voltage regulation problems.

Be sure to see Superior Electric's MOBILE DISPLAY when it is in your area.

*Trade Mark Reg. U. S. Pat. Off.

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THE SUPERIOR ELECTRIC COMPANY
1405 MIDDLE STREET, BRISTOL, CONNECTICUT

Please send prices and more facts on STABILINE Automatic Voltage Regulators ☐ Please have representative call ☐

Name.....

Company Name.....

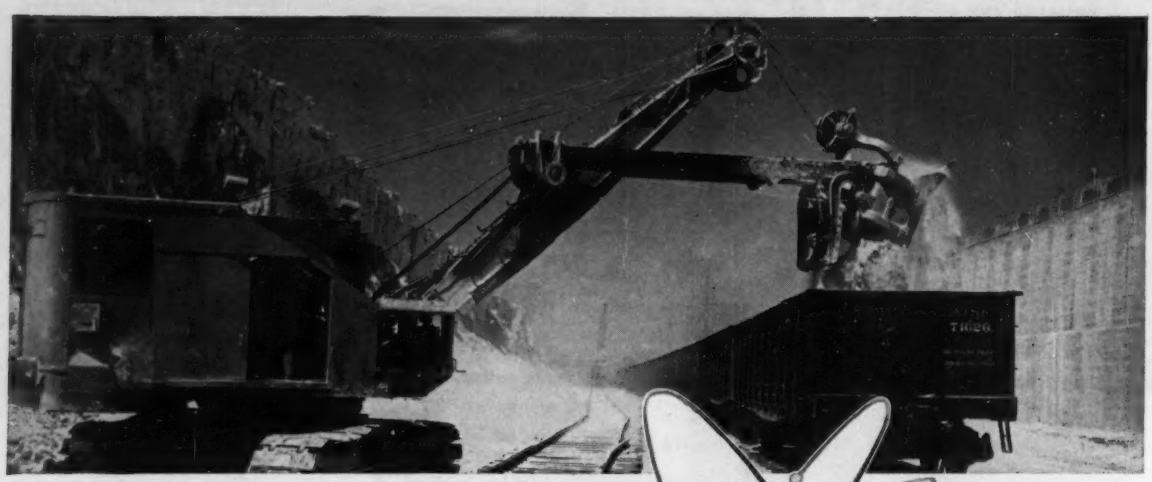
Address.....

City.....*Zone*....*State*.....

SULPHUR

helps to create

headline products



Ore milling specialists have settled upon acid leaching as the most practical and economical way to extract uranium values from ore concentrates. And as with so many other ore-leaching processes, sulphuric acid appears to be the best of the solvents, considering costs and availability.

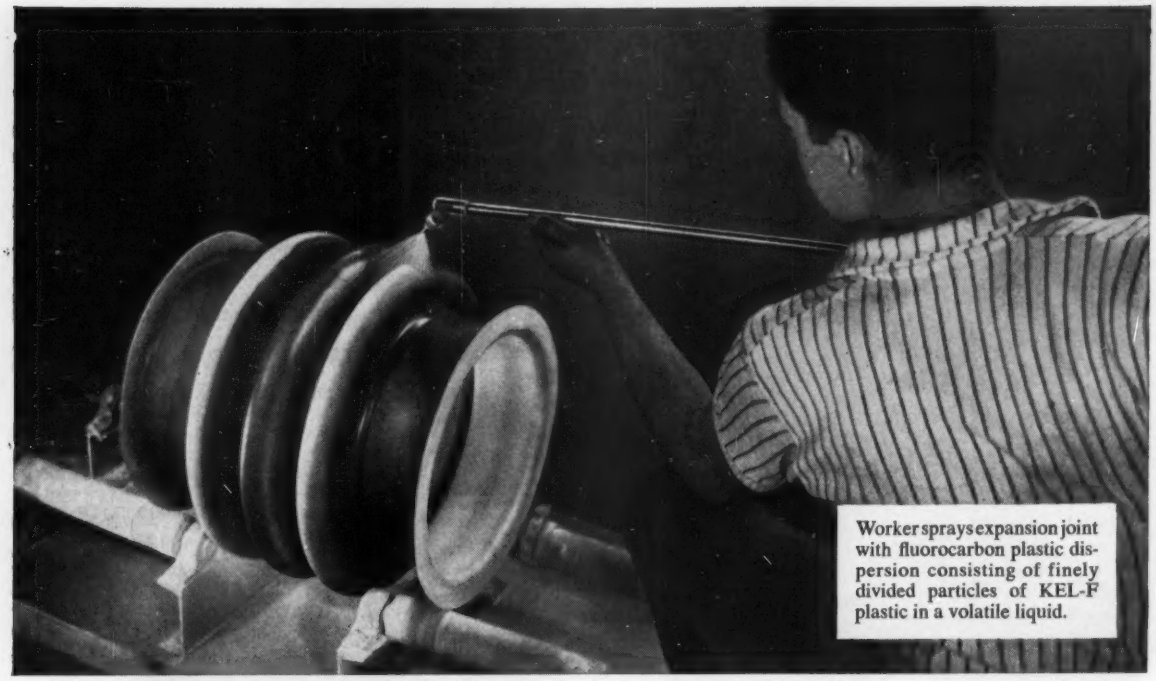
So chalk up another 'headline' end-use for this most widely used of all acids! But this very broadening demand for sulphuric emphasizes the problem facing producers of the basic element SULPHUR. Search for new commercial sources goes on without let-up all over the world. This company is playing a leading role in this search.

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N.Y.

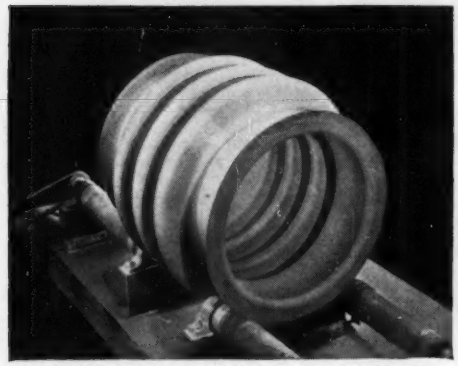
Sulphur Producing Units

- Newgulf, Texas
- Moss Bluff, Texas
- Spindletop, Texas
- Worland, Wyoming



Worker sprays expansion joint with fluorocarbon plastic dispersion consisting of finely divided particles of KEL-F plastic in a volatile liquid.

KEL-F® FLUOROCARBON DISPERSIONS...



Air-dried coating shows uniform coverage of both interior and exterior surfaces with tiny particles of KEL-F plastic.

Baking rapidly fuses plastic particles into a tough, adherent coating with all the important properties of KEL-F plastic.

for corrosion-resistant, protective coatings with anti-adhesive properties

With the new *dispersion* form of KEL-F fluorocarbon plastic, a number of surfaces can be protected with permanent, corrosion-resistant coatings.

KEL-F Dispersions are finely divided particles of KEL-F plastic in a volatile medium. They can be applied by spraying, dip, or spreading to a variety of metallic and certain non-metallic surfaces. High temperature baking fuses the dispersions into tough, adherent coatings that are corrosion-resistant, thermally stable, and anti-sticking.

Thus, fluorocarbon coatings not only protect process equipment from corrosion, but also provide a self-cleaning, non-contaminating surface that insures purity of process stream.

A unique combination of properties of the coatings suggests many areas of use:

CORROSION RESISTANCE—tankcars, piping, pumps, mixers, valves, flow-meters, reactors, containers.

ANTI-STICKING—agitators, calender and guide rolls, forming dies, cone blenders, casting molds.

ELECTRICAL—coated glass tape, distribution transformers, miniaturized stators and relays.

Kellogg will gladly work with you in developing specific applications for KEL-F Dispersions. If you do not maintain your own coating department, we can recommend experienced applicators. Write for more information.

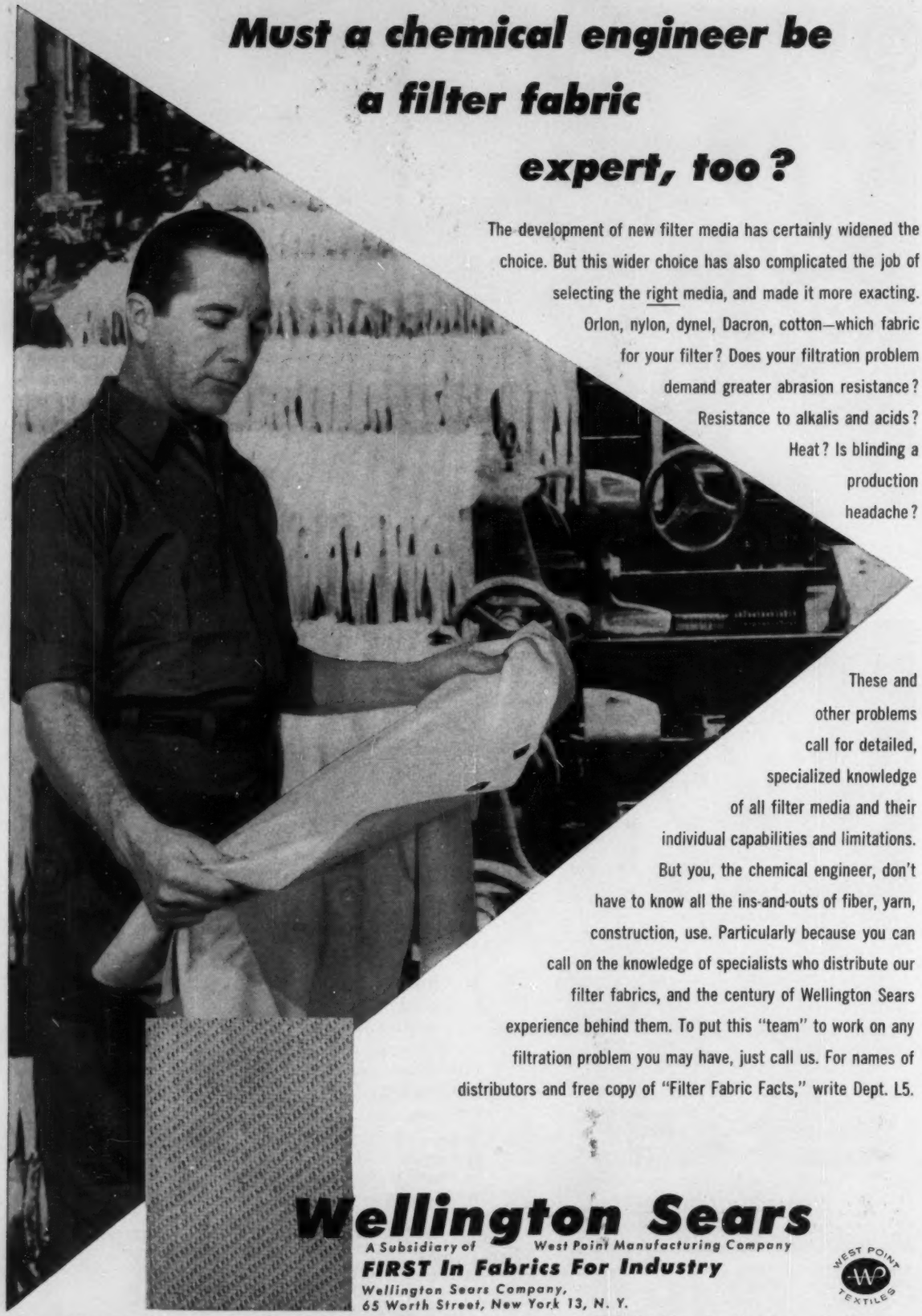
KELLOGG

THE M. W. KELLOGG COMPANY
Subsidiary of Pullman Incorporated
Chemical Manufacturing Division
P. O. Box 469, Jersey City 3, N. J.

®KEL-F is a registered trademark of The M. W. Kellogg Co. for its fluorocarbon products.

Visit the Kellogg Booth #804, 901 Plastics Exposition—June 11-15 Coliseum, New York City

Must a chemical engineer be a filter fabric expert, too?



The development of new filter media has certainly widened the choice. But this wider choice has also complicated the job of selecting the right media, and made it more exacting. Orlon, nylon, dynel, Dacron, cotton—which fabric for your filter? Does your filtration problem demand greater abrasion resistance? Resistance to alkalis and acids? Heat? Is blinding a production headache?

These and other problems call for detailed, specialized knowledge of all filter media and their individual capabilities and limitations. But you, the chemical engineer, don't have to know all the ins-and-outs of fiber, yarn, construction, use. Particularly because you can call on the knowledge of specialists who distribute our filter fabrics, and the century of Wellington Sears experience behind them. To put this "team" to work on any filtration problem you may have, just call us. For names of distributors and free copy of "Filter Fabric Facts," write Dept. L5.

Wellington Sears

A Subsidiary of West Point Manufacturing Company

FIRST In Fabrics For Industry

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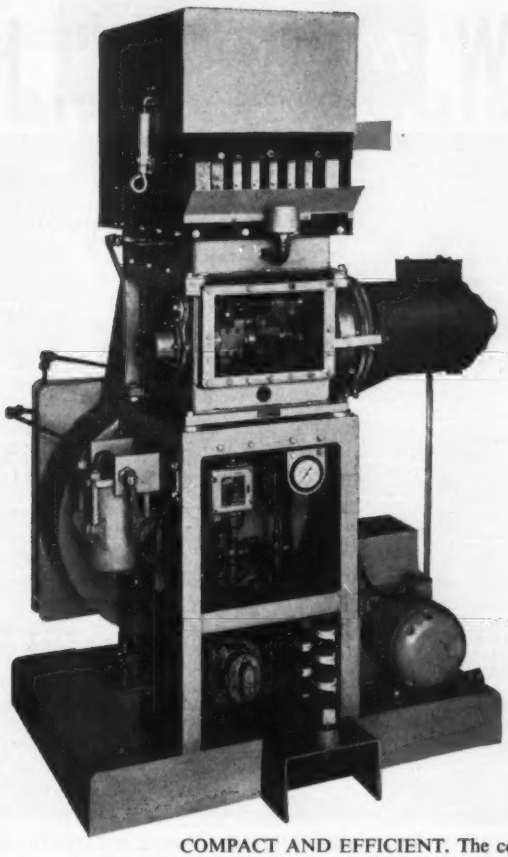
CHEMICAL COMPANIES

- cut power costs
- save space
- increase production



COMPACT AND EFFICIENT. The contact unit is the heart of the I-T-E Mechanical Rectifier. The contacts are pure solid silver, the best conductor known, and driven by a synchronous motor by means of small, light mechanical parts.

with I-T-E MECHANICAL RECTIFIERS

For every unit of product obtained by electrolytic action, the I-T-E Mechanical Rectifier can reduce the amount of electric energy you have to buy.

The I-T-E Mechanical Rectifier normally operates at an overall efficiency of 96% to 97% or even higher. This efficiency can be translated into power savings totaling thousands of dollars annually. Or it can mean higher production for the same power cost.

Besides reducing power consumption, the I-T-E Mechanical Rectifier offers the advantages of small space-requirements and less costly installation. This means greater overall economy. The first user of I-T-E Mechanical Rectifiers has since ordered eight additional units and has specified still more for electrochemical plants now under construction.

Many improvements have been made since I-T-E first introduced the mechanical rectifier. For example, the unit can be restarted immediately after a shutdown caused by backfire—without changing the contacts. And contact life has been increased.

I-T-E Mechanical Rectifiers are available in single units—6000 through 12,000 amp and 24,000 amp from 50 to 250 volts d-c; 6000 amp and 12,000 amp from 250 to 400 volts d-c.

For additional information, write I-T-E Circuit Breaker Company, Transformer and Rectifier Division, 19th & Hamilton Streets, Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY • Transformer and Rectifier Division

HOW HERCULES HELPS...

MULTICOLOR APPEAL—More than 1,000,000 square feet of exterior and interior surfaces of the new Los Angeles Beverly Hilton Hotel have been decorated with single-spray applications of "Zolatone," Paramount Paint & Lacquer Company's multicolor lacquer*. Based on Hercules® nitrocellulose, multicolor lacquers are a fast-drying, economical, and durable decorative finish.

*U.S. Patent No. 2,891,904, held by Colorants Coatings, Inc., Los Angeles.

A PRODUCTION LINE PROBLEM; excessive foam can destroy quality control in the manufacture of paper, synthetic rubber, and other products. A 2½ pound brick of convenient, easy-to-handle Hercules® Defoamer 4, however, can make as much as 40 gallons of highly effective foam control solution. Send for free testing sample.

A NEW SOURCE OF SUPPLY for acetone has been created by Hercules' Gibbstown, N. J. oxychemical plant. From photographic film to nail polish, from paints and lacquers to acetate rayon, acetone plays a vital production role as a solvent.

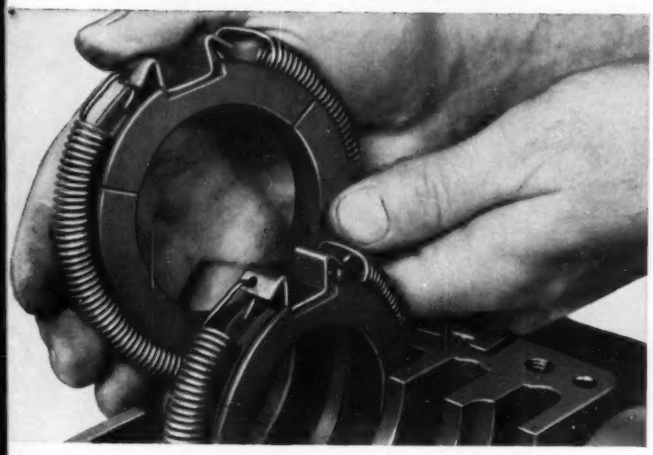
HERCULES POWDER COMPANY
INCORPORATED
952 Market St., Wilmington 99, Del. Sales Offices in Principal Cities
SYNTHETIC RESINS, CELLULOSE PRODUCTS, CHEMICAL COTTON, TERPENE CHEMICALS, ROSIN AND ROSIN DERIVATIVES, CHLORINATED PRODUCTS, OXYCHEMICALS, EXPLOSIVES, AND OTHER CHEMICAL PROCESSING MATERIALS

956-20(8)

HERCULES
CHEMICAL MATERIALS FOR INDUSTRY

On all General Electric High-speed Turbines,

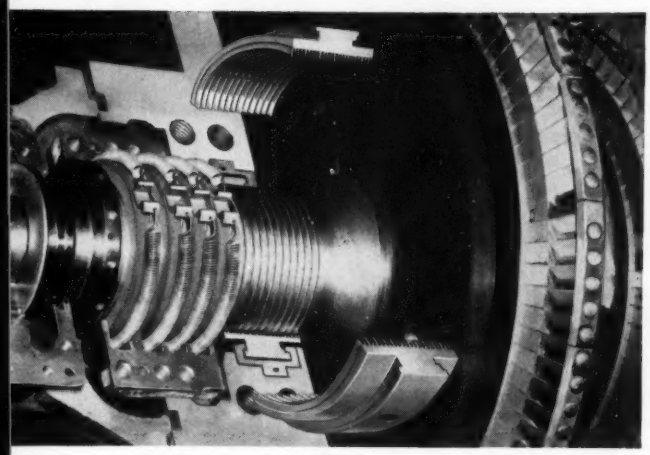
Well-designed, efficient seals...



Low-cost, easily-replaced carbon packings

For the most efficient shaft-end sealing, well-designed, low-cost carbon packings are used on G-E High-speed Turbines to seal steam pressures up to 75 psig. Made of non-galling, self-lubricating carbon-graphite, these segmental rings have high mechanical strength in the small sizes used, assuring long life under normal operating conditions. A garter spring in an offset "V" groove holds each ring together and presses it firmly against the side of the chamber, forming a tight seal This unique arrangement permits the rings to support their own weight and to adjust themselves to the shaft position, thereby reducing wear and increasing the life of the seal. The rings are contained in compact external packing boxes, and can be easily inspected or replaced without breaking the horizontal joint of the wheel casing.

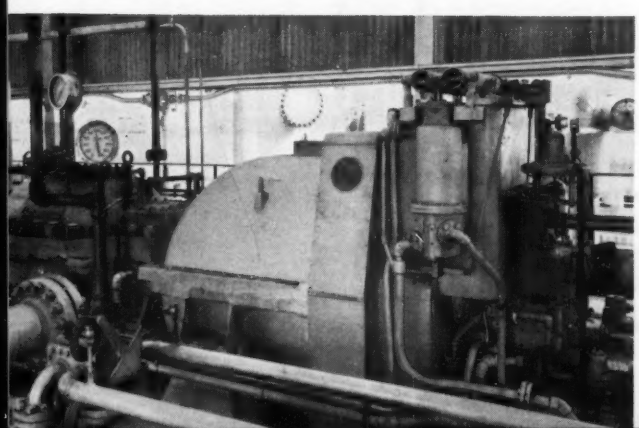
cut steam leakage...



Reliable, long-life metallic-labyrinth seals

To effectively minimize shaft-end steam leakage where shell pressures exceed 75 psig, segmental, high-low tooth metallic-labyrinth seals are used in combination with carbon packing. Between stages, straight-tooth metallic-labyrinth seals are always used. For maximum seal efficiency, minimum clearances between the teeth and the shaft are maintained by precision-machined hook fits in the packing housing. Shaft scoring is practically eliminated since the leaded-bronze segments are spring-backed and can move outward should there be accidental contact with the shaft. When unbalanced steam pressure forces axial movement of the seals, the shoulders of the rings and the housing engage to form a tight steam seal. All labyrinth seals are designed to compensate for thermal expansion, thus assuring a most efficient steam seal at operating temperatures.

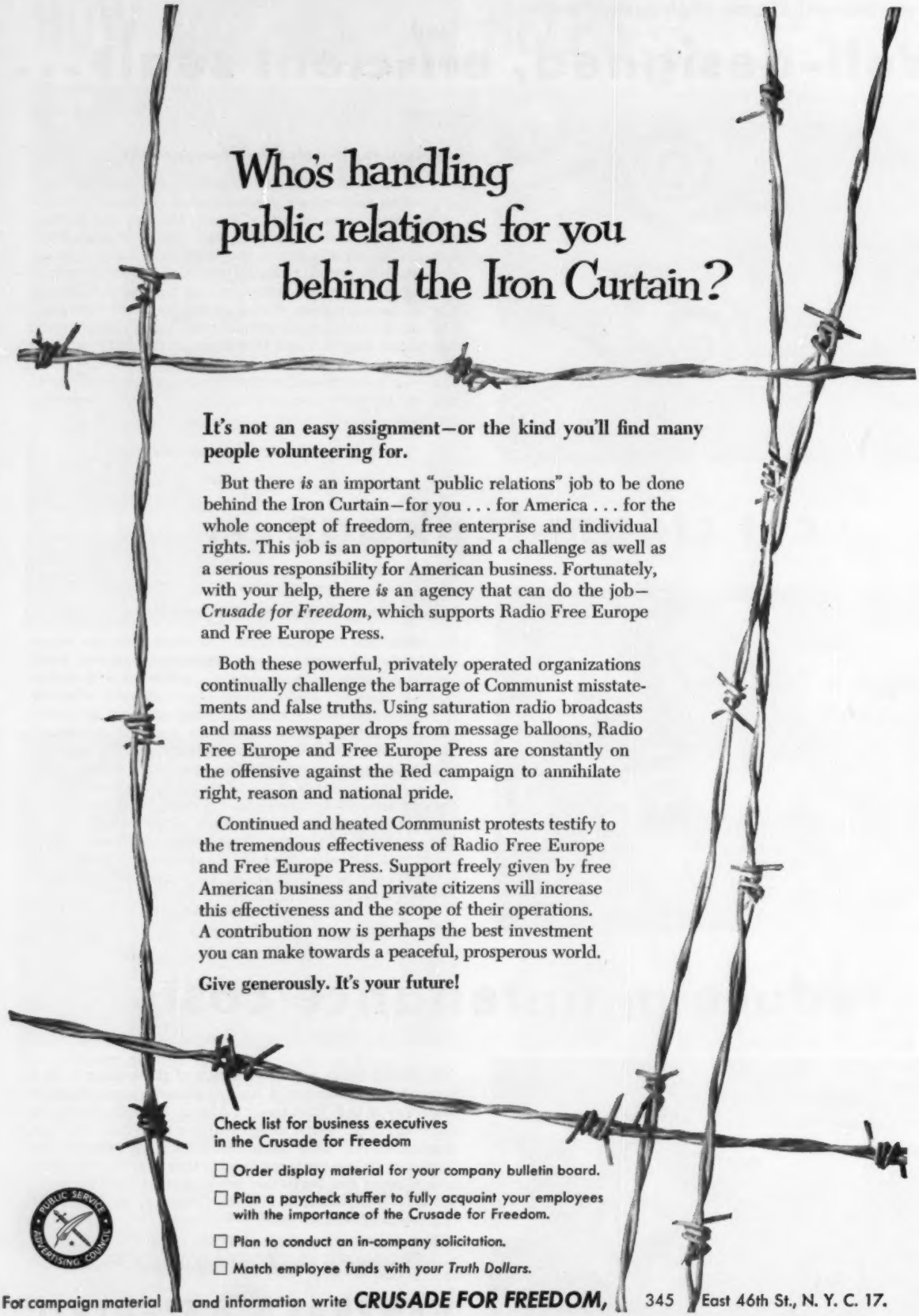
reduce maintenance costs



The careful design and manufacture of these steam seals is your further assurance of low maintenance and consistent reliability of G-E High-speed Turbines. Why not check into the many other sound design features built into these mechanical drives? Your Apparatus Sales Representative will be glad to explain the many benefits they offer to your operation. Contact him for further information or write for Bulletin GEA-6232, General Electric Company, Section 241-7. Schenectady, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC



Who's handling public relations for you behind the Iron Curtain?

It's not an easy assignment—or the kind you'll find many people volunteering for.

But there *is* an important "public relations" job to be done behind the Iron Curtain—for you . . . for America . . . for the whole concept of freedom, free enterprise and individual rights. This job is an opportunity and a challenge as well as a serious responsibility for American business. Fortunately, with your help, there *is* an agency that can do the job—*Crusade for Freedom*, which supports Radio Free Europe and Free Europe Press.

Both these powerful, privately operated organizations continually challenge the barrage of Communist misstatements and false truths. Using saturation radio broadcasts and mass newspaper drops from message balloons, Radio Free Europe and Free Europe Press are constantly on the offensive against the Red campaign to annihilate right, reason and national pride.

Continued and heated Communist protests testify to the tremendous effectiveness of Radio Free Europe and Free Europe Press. Support freely given by free American business and private citizens will increase this effectiveness and the scope of their operations. A contribution now is perhaps the best investment you can make towards a peaceful, prosperous world.

Give generously. It's your future!

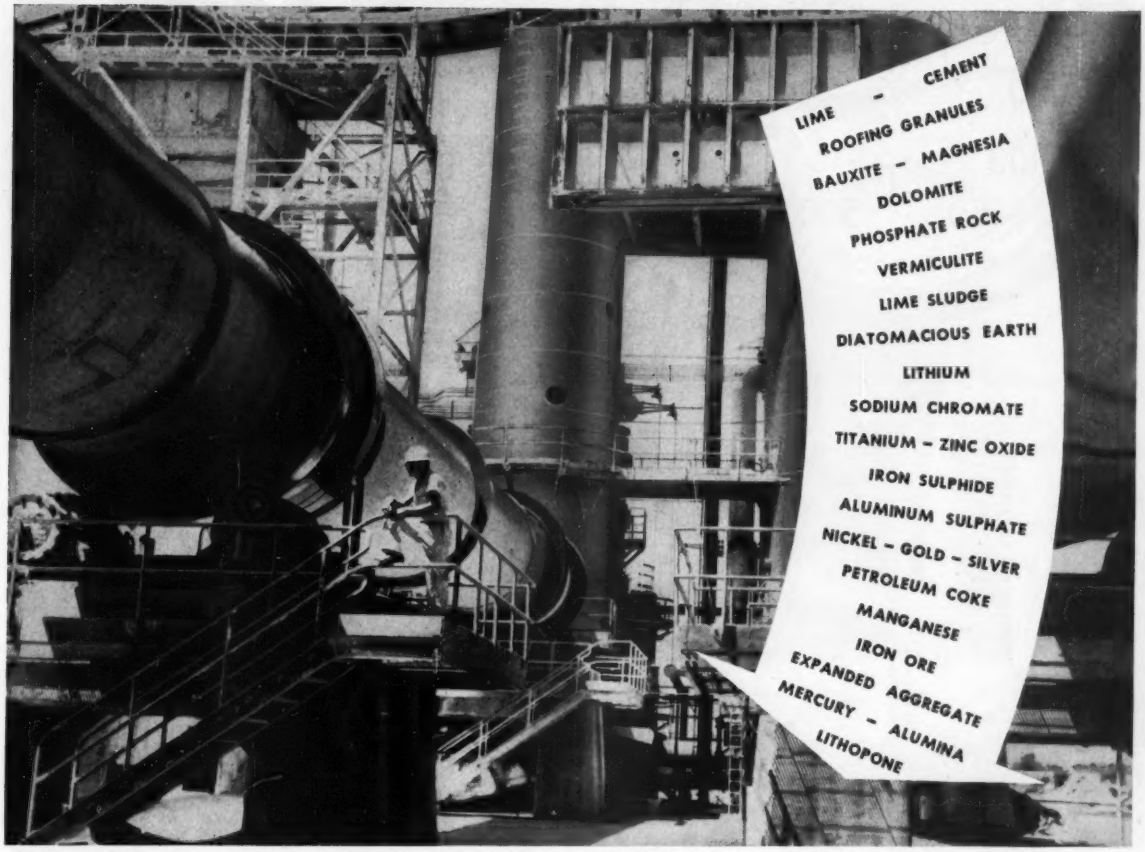
Check list for business executives in the Crusade for Freedom

- ☐ Order display material for your company bulletin board.
- ☐ Plan a paycheck stuffer to fully acquaint your employees with the importance of the Crusade for Freedom.
- ☐ Plan to conduct an in-company solicitation.
- ☐ Match employee funds with *your Truth Dollars.*

PUBLIC SERVICE ADVERTISING COUNCIL

For campaign material and information write **CRUSADE FOR FREEDOM,** 345 East 46th St., N. Y. C. 17.

Traylor's half century of engineering leadership is at your command for more profitable production of many types of products such as:



FOR PRODUCTION ECONOMIES THAT SHOW UP IN PROFITS

Today, throughout the world, leaders in the process industries rely on Traylor Rotary Kilns to insure uniformly high product quality and maximum production efficiency.

With Traylor Rotary Kilns producing profits throughout the processing industry, chances are we have in the past "Traylor-Made" a Rotary Kiln very similar to the one you need for more efficient and profitable thermo-processing of your particular product.

Let Traylor Engineers show you how Traylor Rotary Kilns can achieve production economies that will show up in your profits. Write for Traylor Bulletin 1115 outlining the features of Traylor Rotary Kilns, Coolers and Dryers.

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840 MILL ST., ALLENTOWN, PA.

SALES OFFICES: New York • Chicago • San Francisco
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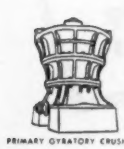
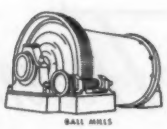
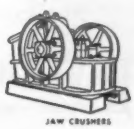
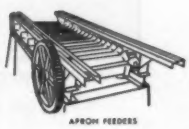

PRIMARY GYRATORY CRUSHERS

ROTARY KILNS

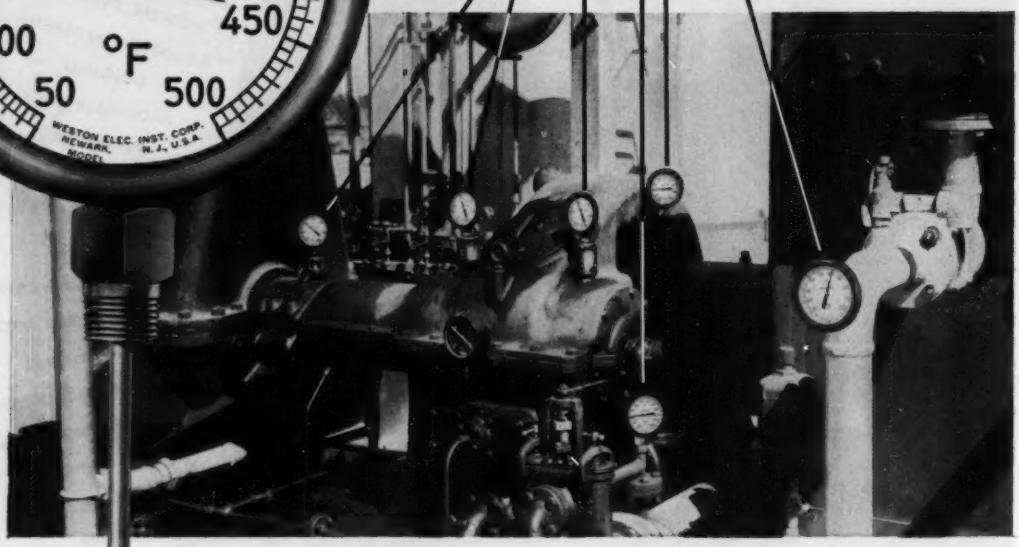
SECONDARY GYRATORY CRUSHERS

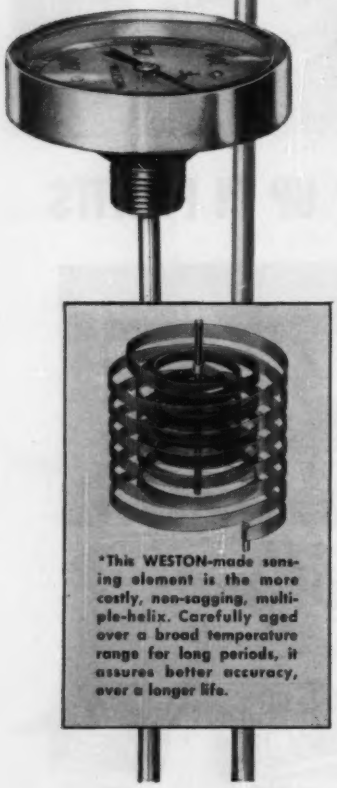

BALL MILLS


JAW CRUSHERS


APRON FEEDERS

AT EVERY CHECKPOINT





*This WESTON-made sensing element is the more costly, non-sagging, multiple-helix. Carefully aged over a broad temperature range for long periods, it assures better accuracy, over a longer life.

WESTON *all-metal* THERMOMETERS

(with Multiple Helix)*

Here's another typical example of how large processing plants have solved temperature checking problems, and cut thermometer costs besides. With a WESTON dial-type thermometer at every checkpoint, temperatures are read at a glance . . . in far less time, and with far greater accuracy. Their sturdy all-metal construction resists breakage, gives them far longer life on operating equipment. And the exclusive WESTON multiple helix employed assures dependable accuracy during all this long life.

Available in a broad selection of types, sizes, ranges and stem lengths, WESTON thermometers are today standard on all types of mobile and stationary equipment and machines, large and small; as well as on piping, conduit, ducts, etc. Ask your distributor, or local WESTON representative for complete information, or write for descriptive bulletin . . . WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey. A subsidiary of Daystrom, Incorporated.

WESTON 5537 *Thermometers*

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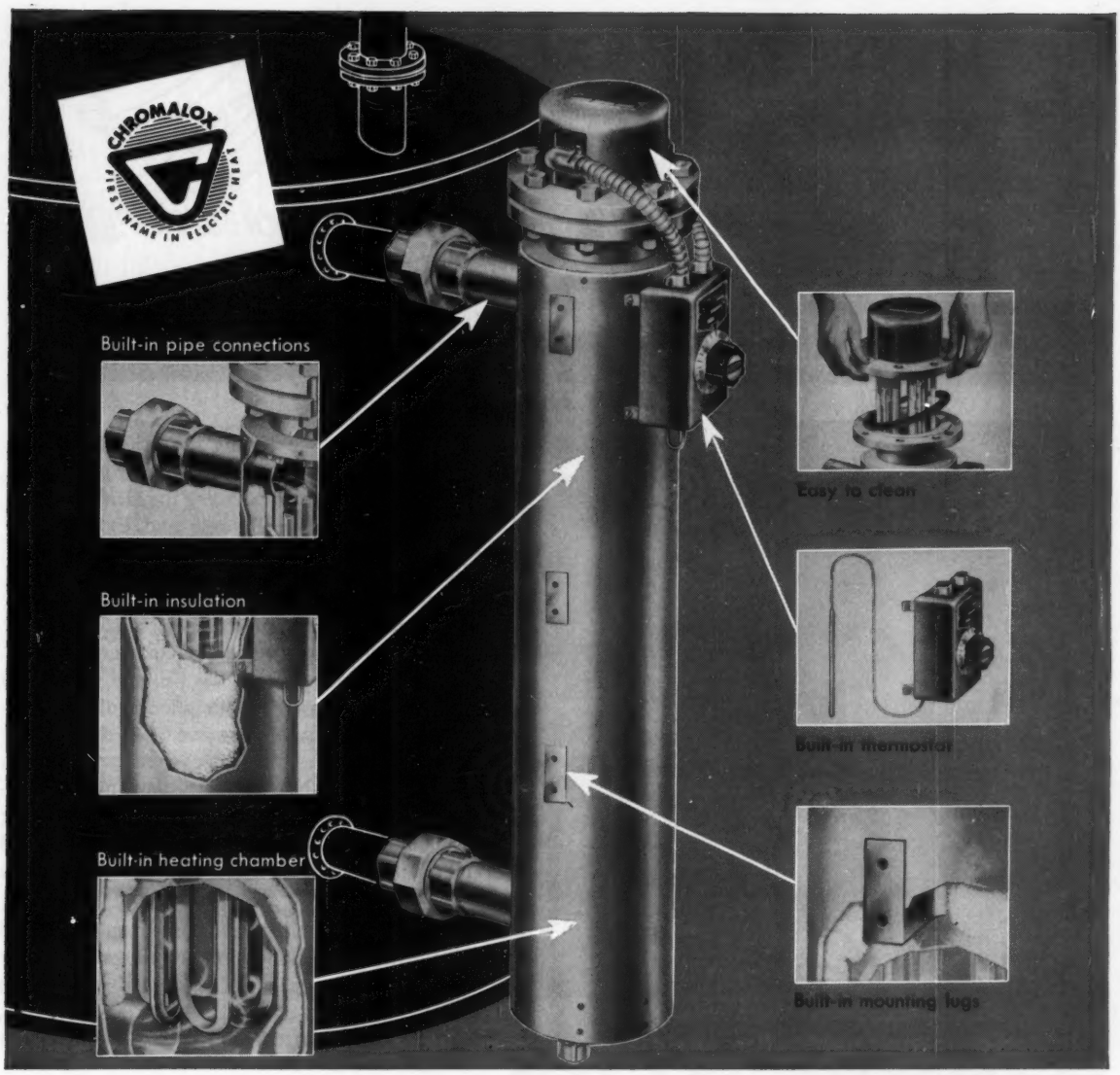

Compact, packaged Electric heating for Liquids and Gases!

Chromalox Electric Circulation Heaters are completely packaged heat exchangers designed for a wide variety of liquid and air heating jobs. In them, you get a complete, compact heating package ready for quick, economical installation. All you do is make the necessary pipe and electrical connections.

What's more, you get all the advantages of electric heat—including accurately maintained heat at the temperatures you select, instant heat-up, without elaborate facilities . . . and high efficiency because you generate heat right at the job.

Compared with fuel-fired systems, the low original cost and operating expense of Chromalox Electric Circulation Heaters helps you realize real dollar savings. There's no expensive firing and upkeep cost.

Whether you are heating water, oils, steam, air or heat transfer media, call your Chromalox representative—he's the man with the electrical answer to your heating problem. B-711

For the full story on Chromalox Electric Circulation Heaters, write for a copy of Bulletin 701.

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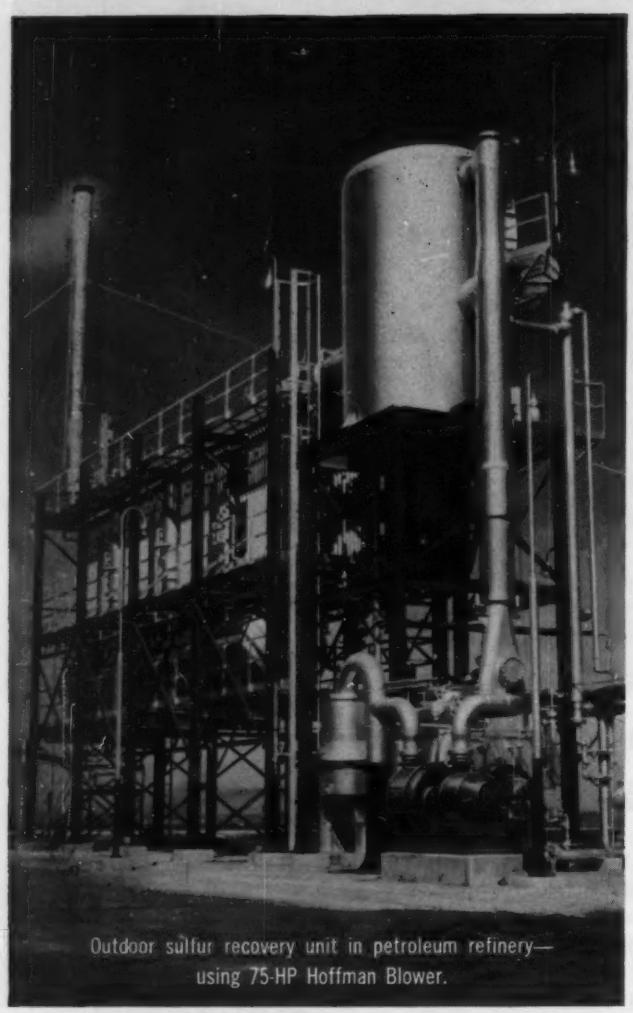
**WHERE THERE'S NEED FOR SMOOTH STEADY AIR SUPPLY—
HOFFMAN CENTRIFUGAL COMPRESSORS GIVE LOW-COST, LONG-RUN SERVICE**



Outdoor sulfur recovery unit in petroleum refinery—using 75-HP Hoffman Blower.

For process work, for drying, degassifying, or cooling—wherever engineers require air or gas moving under pressure, they are finding the ideal answer in Hoffman Multi-stage Blowers and Exhausters.

These air and gas movers are famous for their long-run, trouble-free, quiet, vibration-less performance. Available in a wide range of capacities, they work equally well as pressure or vacuum source—maintaining pressures up to 9 lbs. psi, and vacuum to 12 inches Hg. Power consumption is directly proportional to volume of gas moved. The dynamically balanced multiple-effect impeller assembly works without gears, valves, vanes, pistons, or other impacting parts—the basis for the remarkable long economical service life. The absence of internal lubricating or sealing fluids assures freedom from contamination.

With auxiliary equipment in Hoffman-engineered pneumatic installations, these compressors are building a new concept of efficient conveying—in salvage and recovery, in sanitation and clean-up, and in moving materials in powder and granular forms.

Technical bulletins describing the design and performance advantages of Hoffman Blowers and Exhausters, and pneumatic systems are available on request.

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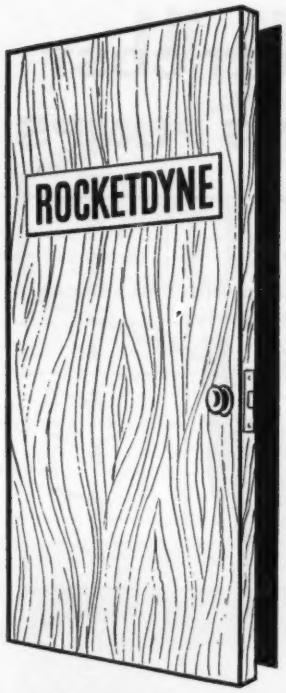

What engineers find behind this door

In the past ten years, hundreds of engineers and scientists have opened this door. To a man, they'll tell you that they are impressed by the challenging, fascinating work – advanced rocket engine development, design and testing.

Daily, engineers find that their job at ROCKETDYNE is a big and important one... concerned with all phases of the rocket engine business... a demanding job, with personal and professional rewards that equal or exceed the demands.

You can find all this—and more: new rocket engines, pumps and powerful turbines, designed to meet the rugged requirements of space flight.

You can open this door to a number of exciting, different fields, one of which will fit your training or experience. You needn't have worked directly in rocket engines or other propulsion systems before. Experience or training in other engineering fields can qualify you for a position at ROCKETDYNE. Listed below are some examples.

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PRELIMINARY DESIGN. Opportunity to conceive, analyze, and evaluate highly advanced concepts in large, liquid-propellant rocket engines, advanced propellants, feed systems, principal components and parameters. Advanced military proposals. Market studies. Operations Research and long-range programming. Advanced degrees preferred.

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COMBUSTION DEVICES. Important professional growth opportunities for engineers heavy on thermodynamic and heat transfer background, as it may pertain to high temperature, high stress components such as thrust chambers, gas generators, injectors, and heat exchangers. Unusual challenges available in work on high-rate heat transfer, pyrotechnics, spark-initiated and hypergolic ignition, combustion mechanics, droplet formation and flame propagation.

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For detailed information, please fill out and mail the coupon below.
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And_____ years actual engineering experience

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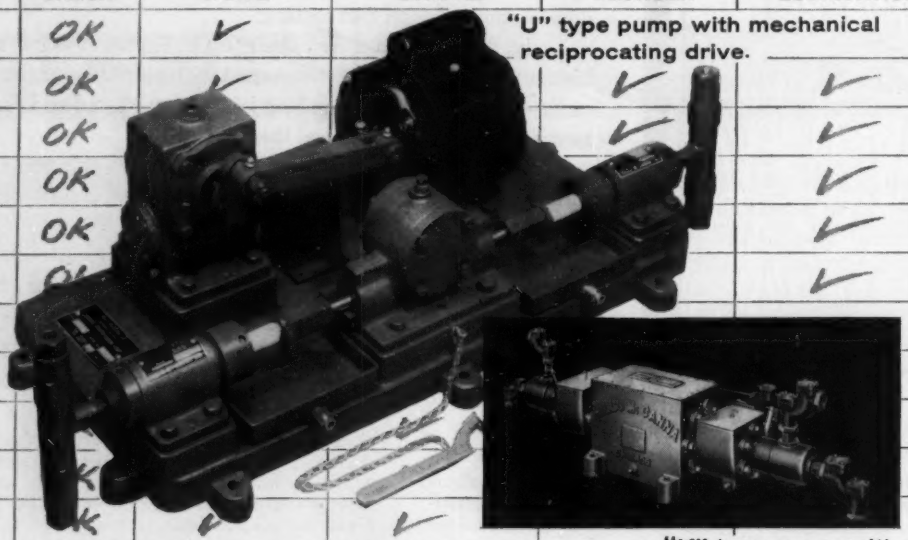
FEBRUARY	OK	✓		✓	✓
MARCH	OK			✓	✓
APRIL	OK				✓
MAY	OK				✓
JUNE	OK				✓
JULY					
AUGUST					
SEPTEMBER					
OCTOBER	OK				
NOVEMBER	OK	✓	✓		
DECEMBER	OK	✓	✓	✓	



"U" type pump with mechanical reciprocating drive.

"K" type pump with hydraulic drive.

HILLS-McCANNA dependability pays off in lower maintenance . . . longer life . . . greater accuracy . . . cost-saving versatility

Maintenance reports from the leaders in many different industries prove the low-cost operation of Hills-McCanna metering and proportioning pumps . . . tell why these pumps are specified for installations requiring the finest equipment. Part replacement is remarkably low because there are few points of wear. Routine maintenance is simple and economical thanks to special Hills-McCanna features, such as separate interchangeable check valves and easy, precise stroke adjustment (even while in operation when desired). Working parts are completely enclosed to keep them dirt-free. All U Type pump bodies are interchangeable in the housing for quick convertibility. Straight reciprocal drive eliminates bushing replacement. And, you'll find Hills-McCanna pumps mighty easy to install.

If you must continuously meter or proportion small volume flows with great accuracy, you'll want to consider the "U" type pump—available in 1, 2, 3 and 4 feed units. The "K" type pump —also available in 1, 2, 3 or 4 feed units—will meet your larger flow requirements.

Hills-McCanna can furnish a pump to meet *every* type of installation . . . with a wide choice of corrosion, wear and abrasion-resistant liquid ends . . . in capacities and pressures for every need.

Write for full facts now. You'll be dollars ahead tomorrow by investigating today!

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offer:

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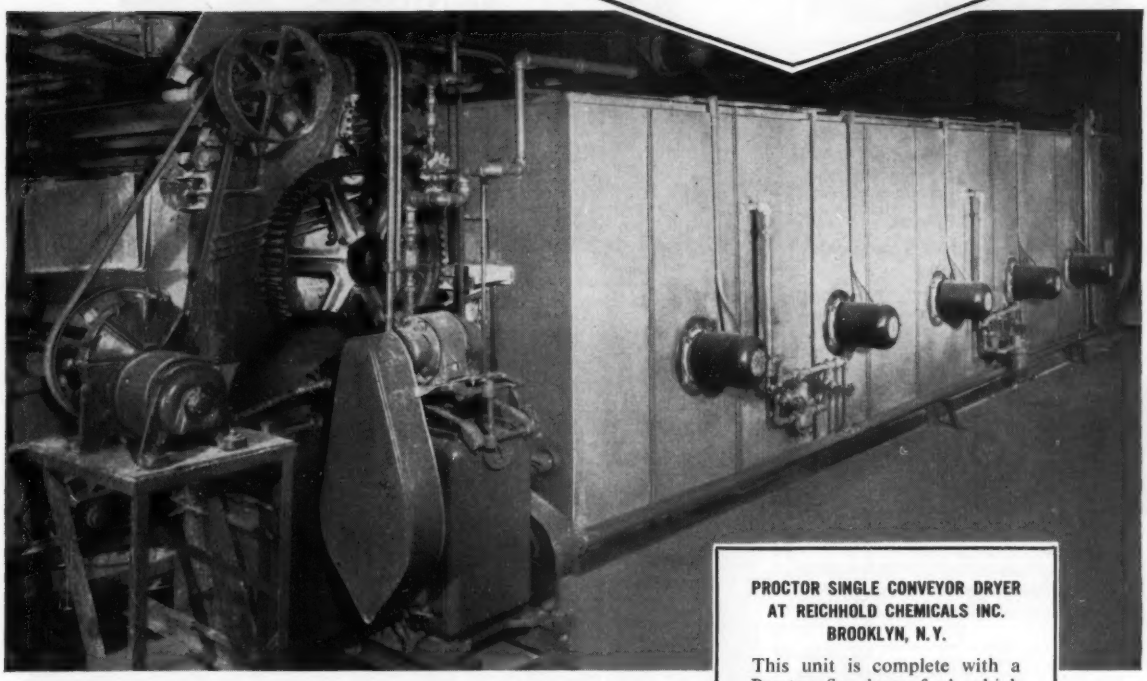

PROCTOR SINGLE CONVEYOR DRYER AT REICHHOLD CHEMICALS INC. BROOKLYN, N.Y.

This unit is complete with a Proctor fin drum feed which preforms pigment into sticks of uniform thickness and deposits them directly onto the conveyor dryer.

In every installation, Proctor Drying Ranges provide higher drying speeds resulting in increased yields, and profits. Proctor equipment offers the control and flexibility essential for uniform drying, insures consistent high product quality.

Many wet-solid materials heretofore considered unsuitable for conveyor drying can now be handled efficiently by means of Proctor pre-forming techniques. And, as always, Proctor equipment carries performance guarantees based on wide experience and careful analysis of the requirements. Write for complete information.

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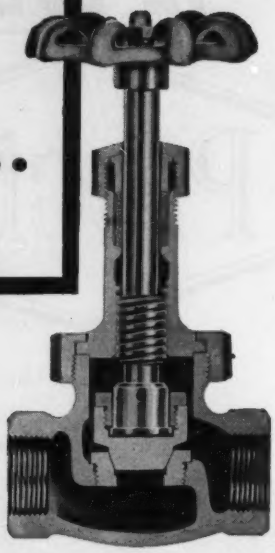
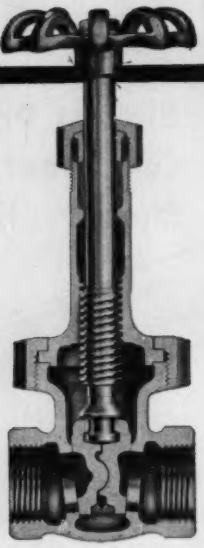
Proctor **PROCTOR & SCHWARTZ, INC.** Philadelphia 20, Pa.

Manufacturers of Industrial Drying Equipment and Textile Machinery

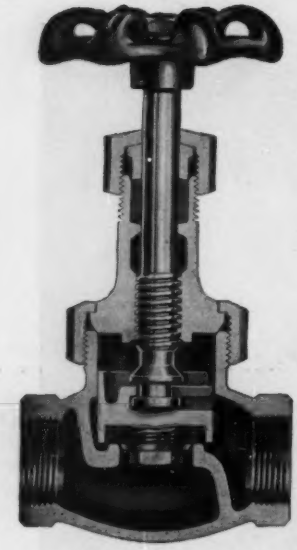
Walworth bronze valves...



Walworth No. 225P Globe Valve
500 Brinell Seat and Disc



Walworth
No. 29 Gate Valve



Walworth No. 95 Globe Valve
Re-New-Disc

built to give dependable trouble-free service on all recommended jobs

Walworth No. 95 Bronze Globe Valves (Angle Type: No. 96) are recommended for service where throttling is not required. They are rated at 150 psi working steam pressure, 500F; 300 psi cold water, oil or gas. The improved renewable disc and lock-on, slip-off disc holder — an original Walworth development—saves time and trouble. This valve can be repacked under pressure when fully opened. All parts are designed to give maximum service and strength.

Walworth No. 29 Bronze Gate Valves are rated at 200 psi working steam pressure, 550F; 400 psi cold water, oil and gas. These valves have rising stems and integral seats. Sizes 2-inch and smaller have union bonnets; sizes 2½ and 3-inch have bolted bonnets. Valves up to and including ¾-inch have solid wedge discs; 1-inch and larger have split wedge discs. These valves can be repacked under pressure when fully opened.

Walworth No. 225P Bronze Globe Valves (Angle Type: No. 227P) are rated at 350 psi working steam pressure, 550F; and 1000 psi non-shock service on cold water, oil and gas. The stainless steel, plug type seat and disc — heat treated to 500 Brinell — can be closed on sand, slag, scale and similar floatage, without injury to the seating surfaces. They are the longest wearing, TOUGHEST bronze valves you can buy.

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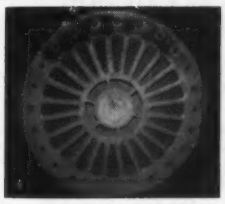

RUBBER LININGS THAT RESIST CORROSION

Acme Fisher corrosion-preventing rubber lining and covering can be applied to almost anything. You can depend on getting the correct formulation to provide the highest degree of protection and at the correct price.

Write for price list on rubber lined pipe and fittings. For special jobs write, wire or call for quotation.

Acme Fisher Division
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J. E. SIRRINE COMPANY
Engineers
Plant Design & Surveys covering Chemicals, Electrochemical and Metallurgical Production; Trade Waste Disposal; Water Supply & Treatment; Analyses & Reports.
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J. A. GUSTIN & ASSOCIATES
Consulting Engineers and Technologists
Fluid Energy Grinding, Micronizing, Milling, Classification, Multi-wall bag packaging, Plant Layout and Design, Reports, Investigations. Serving the Lime, Cement, and Industrial Minerals Field.
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Industrial Waste Treatment
Water Supply and Water Purification
Stream Pollution Investigations
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TECHNICAL ENTERPRISES, Inc.
Engineers—Consultants—Chemists
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Complete Engineering Services
Product & Process Research & Development
SPECIALISTS IN SMALLER MANUFACTURING PLANTS
31 South St., New York 4, N. Y. WH 3-1544

HALE AND KULLGREN, INC.
Specialists in Processes and Plants for Rubber and Plastics
A Complete Engineering Service
including: Economic Surveys; Process Design; Installation; Contracting and Operation
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CHEMICAL AND PETROLEUM PROCESS PLANTS
Design - Procurement - Construction Supervision
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Specialists in the chemistry, electrochemistry and production of fluorine, chlorine and iodine tungsten, chromium, boron, titanium, uranium, selenium, manganese, cobalt, and nickel and their compounds
38-15 30th Street Long Island City, N. Y.

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Thermal Process Technology
A Supporting Staff of Fifty Engineers, Designers, Detailers
7016 Euclid Ave., Cleveland 3, O.
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New York 5. Washington 5.

PATCHEN AND ZIMMERMAN ENGINEERS
Chemical, Process, and Industrial Plants
Investigations — Reports — Design — Supervision
Augusta, Ga. Atlanta, Ga. Anniston, Ala.

THE J. G. WHITE ENGINEERING CORPORATION
Design - Construction - Reports - Appraisals
80 Broad Street, New York 4

"By reason of special training, wide experience and tested ability, coupled with professional integrity, the consulting engineer brings to his client detached engineering and economic advice that rise above local limitations and encompasses the availability of all modern developments in the fields where he practices as an expert. His services, which do not replace but supplement and broaden those of regularly employed personnel, are justified on the ground that he saves his client more than he cost him."

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

RATES

DISPLAYED
The advertising rate is $23.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
An advertising inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.
Subject to Agency Commission

UNDISPLAYED
$1.80 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.
Position Wanted ads are ½ of above rate.
Box Numbers—counts as 1 line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions. Not subject to Agency Commission.

Send NEW ADS and Inquiries to Classified Advertising Division of CHEMICAL ENGINEERING, 330 W. 42nd St., N. Y. 36, N. Y.

SALES REPRESENTATIVE

Opening available for capable man with Used and Rebuilt Chemical Process Equipment Company. Challenging and interesting assignments. Salary to commensurate with ability. Location: Metropolitan Area. Send details regarding qualifications and experience. No age limitations. All letters strictly confidential. Our employees know of this ad.

SW 1276 Chemical Engineering
330 W. 42 St. New York 36, N. Y.

OPERATING ENGINEER

Graduate engineer (preferably Ch.E.) with operating experience for operational & supervisory position in synthetic ammonia plant employing a partial oxidation process.

Excellent opportunity for permanent employment in design engineering department of a major engineering & contracting firm.

Send complete resume including education, experience & salary requirements. All replies confidential.

P-1318, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

WANTED

CHEMICAL ENGINEERS

For process development and production work. Two to five years' experience preferred. Modern expanding chemical manufacturing plant in New Martinsville, West Virginia. Long-range multi-million-dollar expansion program now in progress. Modern research and development facilities just completed. Excellent opportunities.

Write

COLUMBIA-SOUTHERN CHEMICAL CORPORATION
New Martinsville, W. Va.

***Attention:* Industrial Relations Dept.**

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)
LOS ANGELES: 1125 W. 6th St. (17)

POSITIONS VACANT

Graduate Engineers, Preferably chemical for both headquarters consulting and field sales work. For sales, should have 3 or more years successful record. For consulting, young men preferred so that our business can be taught and they can move up. Write P-9197, Chemical Engineering.

Technical Director for Powder Equipment technical graduate experienced in equipment for powdered materials. Familiar with good and bad features of existing grinders, classifiers, collectors, analyzers, etc., and markets for same. Suitably educated to propose and develop novel equipment. Excellent future with internationally known Philadelphia company recently entering this field. P-1359, Chemical Engineering.

EMPLOYMENT SERVICES

Salaried Positions $5,000 to $35,000. We offer the original personal employment service (established 46 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered, present position protected. Ask for particulars. R. W. Bixby, Inc., 553 Brisbane Bldg., Buffalo 3, N. Y.

Salaried Personnel, $5,000-$35,000. This Confidential service established 1920, is geared to needs of high grade men who seek a change of connection, under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. L. P. O. Box 674, Manchester, Vermont.

POSITIONS WANTED

Project Engineer—15 years as project manager for many types of chemical plants. Exceptional background of processes, equipment, and plant startups. Well qualified for staff position of chemical manufacturer. PW-1399, Chemical Engineering.

Chemical Engineer. M.Sc. English spoken, wish to emigrate. Age 30. Entering: Autumn. Please reply Box 9930, Polacks Advertising, Copenhagen, Denmark.

EXCEPTIONAL OPPORTUNITY FOR PROCESS DESIGN ENGINEERS

Large eastern chemical industrial concern has openings at Niagara Falls, New York for process design engineers with B.S. or M.S. degree in chemical, electrical, or mechancial engineering. Responsibilities will involve sufficient knowledge to translate pilot plant and process development information into full scale plant design. Electrical engineers with rectifier experience helpful. Prefer five years industrial experience. Excellent facilities, salary and opportunity above average.

Your reply will be held confidential. Include age, education, experience, and salary requirement. Our employees know of this ad.

P-9368, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

ADVERTISING MAN WANTED FOR TECHNICAL PRODUCTS

- **Previous advertising experience not necessary but helpful. Must have at least two or three years of college with courses in engineering and technical subjects and like to write If you have the qualifications we have an opportunity open for you. Man selected will be trained in all phases of industrial advertising. In your letter of application state age, education, positions held, and give statement of why you want a career in advertising. Location: well-known Connecticut company.**

P-1209, Chemical Engineering
330 W. 42 St, New York 36, N. Y.

CHEMICAL ENGINEERS

An active, confidential service!
Interview at your convenience.

Call, write or wire
GLADYS HUNTING (Consultant)
DRAKE PERSONNEL, INC.
220 So. State St. Rm. 628 Chicago 4, Ill.
HArrison 7-8600

TECHNICAL DIRECTOR

New division of multiple plant manufacturer plastics, resin and rubber products and adhesives offers unusual opportunity to young man with supervisory experience or potential. Starting salary $12,000. Company pays agency fee and relocation expense.

MONARCH PERSONNEL
28 E. Jackson Blvd. Chicago 4, Ill.

CHEMICAL ENGINEER

For control laboratory and supervising general plant operations on evening shift at each of two branch plants of national manufacturer. Plants located in Camden, N. J. and Charlotte, N. C. Specify choice of location. Age preference 24 to 35. Give age, education, experience and salary expected. Recent snapshot if available. Replies confidential.

P-1050, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

Procter & Gamble

needs

CHEMICAL ENGINEERS

(Graduated within last 10 Years)

- Permanent positions in Chemical Process Equipment Design and Application and other Engineering Fields.
- Salaries commensurate with education and industrial experience.
- Opportunities to grow with a leading chemical processing company—rated as one of the nation's three best-managed companies by the American Institute of Management.

For application form and further information write

Mr. J. E. Gale
Head of Employment
Engineering Division
The Procter & Gamble Company
Cincinnati 17, Ohio

WANTED
TECHNICAL EDITORS

To provide for its continued growth Chemical Week is seeking two additional assistant editors — preferably chemists or chemical engineers with two to three years business experience. Essential: Ability to meet people, dig out facts, interpret them intelligently and write lucidly. Please submit resume to:

PERSONNEL DIRECTOR
McGRAW-HILL PUBLISHING CO.
330 W. 42ND ST.
NEW YORK 36, N. Y.

ENGINEERS
for plant and Equipment Design

Permanent positions on the engineering staff of this company are now open for Mechanical, Civil, Electrical, and Chemical Engineers with 0-5 years experience. Responsibilities consist of application engineering, equipment design, field supervision, and project engineering. Location: Memphis, Tennessee. Starting salary based on qualifications. Attractive employee benefit plan includes profit sharing, insurance, and vacations. Send resume to:

Technical Division, Personnel
The Buckeye Cellulose Corporation
Memphis 8, Tennessee

ENGINEERS
DESIGNERS
DRAFTSMEN

WITH REFINERY & CHEMICAL PLANT EXPERIENCE IN

PIPING
ELECTRICAL
INSTRUMENTATION
STRUCTURAL
VESSEL
MECHANICAL

APPLY
OR
SEND RESUME TO

PARSONS
617 So. Olive
Los Angeles 14, Calif.

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES | EQUIPMENT - USED or RESALE

UNDISPLAYED ——***RATES***—— ***DISPLAYED***

$1.80 a line minimum 3 lines. To figure advance payment count 5 average words as a line.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

The advertising rate is $16.95 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

Send NEW ADVERTISEMENTS to N. Y. Office, 330 W. 42nd St., N. Y. 36, N. Y. for June issue closing May 3rd

We'll Grind Chemicals More Quickly, Efficiently . . . and Save You Money!

- We have fluid energy mills, hammermills, blenders, sifters, liquid impregnators, packaging equipment. We can give you ultra-fine grinding, intimate blending, drying, removal of contaminants or separation by gravities, close control of particle size, increased surface and absorption.

Use our facilities for your

RESEARCH
PILOT PLANT STUDIES
MARKET EVALUATIONS
SALES DEVELOPMENT
PROCESSING DEPARTMENT

Phone, wire or write today—our custom grinding and processing service can save you time—and MONEY!

Pittsburgh Plate Glass Co.
Corona Chemical Division
Moorestown, New Jersey.

WE HAVE CLOSED DOWN AND ARE RECLAIMING FOR SALE OUR TALLANT, OKLAHOMA CHEMICAL PLANT WHERE FORMALDEHYDE, ACETALDEHYDE, METHANOL, AND OTHER CHEMICALS WERE MADE. INVENTORY AVAILABLE UPON REQUEST.

CITIES SERVICE OIL
PARTRIDGE,
BARTLESVILLE, OKLAHOMA.

FOR SALE

Five used 7500 gallon
Water Storage Tanks
7' diameter x 26' long

SEABOARD METAL & SALVAGE Corp.
186 Third Street
Brooklyn 15, New York
MAin 4-5860, 1, 2, 3

STAINLESS REACTOR

300 Gal. Type 316 Stainless 75# WP Jacket 100# WP or full vacuum internal. Turbine agitator, Dowtherm boiler 200 KW. Sold as unit, Exc. Cond.

CALIFORNIA MACHINERY EXCHANGE
420 Market St. San Francisco, Calif.

BUY OR SELL

Steel, aluminum, stainless steel, or polyephylene drums. Sizes 15-30-55 gallons.

JOHN EDWARDS
350 Rider Avenue Bronx 51, N. Y.
Mott Haven 9-4870

SEE OUR STOCK

FOR SALE
POWER PLANT
in Amarillo, Texas

G. E. Steam Turbine Generator Unit, 6500 KW, 8125 KVA, 1800 RPM, 235 PSI, 4150 volts. With Exciter. Also Westinghouse 12,000 sq. ft. Surface Condenser with pumps.
Comb. Eng. Heine Boiler, natural gas fired, 300# WP, 12,500 sq. ft. heating surface. With boiler feed pumps and condensate pumps.
P & H 35 ton Overhead crane, 40' span.
50,000 gal. Steel Tower Tank, 100' legs.

CENTRIFUGALS

1—AT&M Susp. 48" dia. Perf. Basket, St. St., Fume tight.
1—Fletcher Susp. 40" dia. Imperf. Basket, Steel
1—Tolhurst Susp. 26" dia. Imperf. Basket, Steel
1—Bird 36" x 50" Solid Bowl, Steel
1—Bird 24" x 24" Horiz. Steel
6—DeLaval Nos. 74-11; 94-01; 600, LA-11

DRYERS

4—Devine #27 Vacuum Shelf, 475 sq. ft.
1—Devine #23 Vacuum Shelf, 365 sq. ft.
2—Devine Vacuum Shelf Dryers, size 17, 80 sq. ft. UNUSED.
1—St. St. Spray Dryer, 19' dia. x 20' high, with Western Precip. nozzles, fans, oil burners, etc.
1—Bowen 5' dia. Stainless Steel Spray Dryer
1—Stokes 3' dia. x 15' long Jacketed Rotary Vacuum Dryer
4—Double Drum Dryers: 42" x 120"; 24" x 60"; 24" x 36"; 22" x 38"
8—Rotary Hot Air Dryers or Kilns: 5'6" x 50', 4'6" x 40', 3' x 24'
2—Rotary Coolers: 104" x 30' and 104" x 70'
1—B & S Rotary Hot Air Dryer, 3' x 15', Everdur
3—Rotary Furnace Tubes 24" D x 8'6" L x ¾" Chrome nickel Alloy
1—Hardinge XC-2 Ruggles Coles Rotary Steam Tube Dryer, 4' D x 30' L
2—Davenport Rotary Steam Tube Dryers, 6' dia. x 40' long
2—Davenport size 2A Dewatering Presses
2—Swensen Walker Crystallizers, steel, jacketed, each 30' long

EVAPORATORS—STILLS

1—Goslin-Birmingham 6775 sq. ft. Quadruple Effect, Vertical, Long copper tubes
1—Conkey 1900 sq. ft. Triple Effect, Vertical long Herculoy tubes
1—Buflovak size 6.5 model 629D Double Effect, all stainless steel, 588 sq. ft.
1—Stainless Steel, 145 sq. ft. coil, 500 gal.
1—Stokes 150 gal. St. St. Jacketed Vacuum Still
15—Columns—Aluminum, Copper & Stainless Steel

AUTOCLAVES

2—Blaw Knox ½ gal. St. St. agit. 2000# Pr.
3—St. St. T347, 13 gal. 1400# test, 50# jkt.

FILTERS

Niagara Model 510-28 type 316 Stainless Steel Filter, 510 sq. ft. with extra set leaves.

1—Bird 40" x 60" Contin. Centrifugal Filter
2—Eimco 10' x 12' Rubber Covered Filter
3—Sweetland Filters: #12 (72 lvs.); #5 (20 lvs.); #2 (18 lvs.)
1—Swenson 8' x 8' Rotary Vacuum Filter, Precoat type. Acid proof construction
5—Cast Iron Filter Presses, 30" x 30" open delivery, 28, 35, and 50 chambers
4—Filter Presses, closed delivery, 12" to 36"

MILLS

1—Patt. Fdy "DJ" Unlined Jacketed Steel Ball Mill, 6' dia. v 8' long—UNUSED
4—Pebble Mills 6' D x 8' L, 45" x 42"
1—Al. Ch. 6' Dx 16' L Steel Lined Contin. Ball Mill
3—4'6" D x 12' L contin. Pebble Mills
1—Hardinge 6' D x 22" L Conical Ball Mill, Steel Liner
1—Charlotte #50 Colloid Mill, 75 HP
1—Penna Ring Type Granulator, Trojan K3-24, 40 HP
3—Fitz. Comminutors St. St., F-8, K & D
5—Hammer Mills: Jeffrey 42 x 36; Gruendler 36 x 24; Jay Bee 75 HP; Williams 14" x 14", Williams size A, St. St. and Aluminum
1—Sturtevant 8 x 10 Jaw Crusher
3—Attrition Mills, 30", 24" & 16"
1—Pug Mill, St. St., two 7" dia. overlapping chambers 3'9" L. Jktd.
3—Mikro Pulverizers #2-DH, 2-TH, 3-TH

MIXERS—BLENDERS

2—Day 75 gal. work. cap. Stainless Steel Sigma Blade double arm jacketed mixers
2—Readco Heavy Duty Double Arm Sigma Blade Jacketer Mixers 50 gal. work. cap. 30 HP Expl. Pr. Motor. Built 1951-53
4—Sprout Waldron size 12 Ribbon Mixers, 336 cu. ft. work. cap.
3—W & P Sigma Blade Double Arm Jacketed Mixers, 50 gal. & 100 gal. work. cap.
9—Side Entering Stainless Steel Mixers, 7½ HP, 10 HP, 15 HP & 25 HP
3—Falk Vertical Agitator Drives #10-GDX, 10:1, 300 HP—UNUSED
8—Turbo Vertical Drives, #5B, 5:1, 40 HP

JUST PURCHASED
MARCO FLOW-MASTER UNITS
Stainless Steel
New in 1952—Expl. Pr. Motors

1—KACR Reactor, ser. #3127
1—Kom-Bi-Nator, 200 GPH #3114
1—AC-500 Homogenizer, #3125
2—Roto-Feed Mixers, #3129, 3130
1—DP-Dry Proportioner, #3131
1—AC-Pump, #3126
1—M-100 Pump, #3166

TANKS

12—Aluminum, 3000 gal., 5 compart.
10—Aluminum, 500 gal., 80# WP.
1—Monel, 450 gal., coils; ¼"
1—St. St., T304, ⅛" 10,500 gal. Horiz.—UNUSED
1—St. Clad, T304, 3/16", 6500 gal. Vert.
1—St. St. T316, 5/16", 4000 gal. Hor.
10—St. St. Pressure Tanks—to 4000 gal.
20—St. St. Storage Tanks—to 1000 gal.

HQ FOR STAINLESS STEEL EQUIPMENT

USED EQUIPMENT IN STOCK—Tanks, Kettles, Receivers, Exchangers and Condensers, Stills, Agitators, etc.

NEW TANKS IN STOCK—From 30 gal. to 10,500 gal. sizes. Also large stock of prefabricated tank sections and heads to assure quick delivery of tanks.

CONVERTING EXISTING EQUIPMENT—(Your own equipment or our stock)—Can be done in our own shops utilizing surplus new or used materials on hand. HELIARC WELDING—Water quenched stabilized welds.

Equipment Bought & Sold

Plants Liquidated

PERRY EQUIPMENT CORP.

Phone ST evenson 4-7210

Cable—PERI

1413-21 N. 6TH ST. PHILADELPHIA 22, PA.

Late Type Rebuilt Equipment UNION

Rebuilt Machinery Established 1912

For Immediate Delivery — Great Savings

MIXERS

850 gal. Jacketed Mixing Tanks.
Day 35 to 75 gal. S. J. Imperial Double Arm Mixers.
Day 650 gal. Jumbo S. J. Mixer.
Stokes, Day, New Era, Hottman Mixers, from 2 to 450 gal., with and without Jackets, Single, Double Arm Agitators.
Baker Perkins, Day, Readco Heavy Duty, 2 to 160 gals., Double Arm Jacketed Mixers with Sigma or Fish Tail Blades.
Gemco 56 cu. ft. Double Cone Blender.
J. H. Day 50 gal. Imperial S. S. Jacketed Double Arm Mixer.
Day, Robinson, Bailey, 15 to 10,000 lbs., Dry Powder Mixers.

LABELERS

Models D and NA4 Knapp Wraparound Labelers.
Resina LC and Elgin Cappers.
Burt Wraparound Labeler, to gal.
Pony M, MX, ML, World, Ermold, Pneumatic Semi and Automatic Labelers.
Capem 4-Head Automatic Labeler.

FILLERS

Horix and Elgin Rotary Fillers.
S. & S. G1, G2, G6, HG88 Fillers.
MRM S. A. Stainless Steel Vacuum Fillers.
Triangle Elec-Tri-Pak Fillers, all sizes.
Elgin 5-Head, Hope 1, Filler 2 and 4-Head Stainless Steel Piston Fillers.

PACKAGING MACHINES

Standard Knapp 429 Carton Sealers.
Pneumatic Scale Packaging Units with high speed Carton Feeders and Bottom Sealers, Weighers, Top Sealers with Compression Drying Units, Carton Liners, interconnecting conveyors.
Palmer Box Forming Machine.
ABC Automatic Carton Sealer.
Miller, Hayssen, Package Machinery, Oliver, Campbell, Transwrap Wrappers.
Stokes and Smith Model B Transwrap with Auger Feed and Fin Seal Attachment.

GRINDING MILLS—SIFTERS

Mikro 3TH Pulverizers with 30 HP motors.
Mikro 2TH, 1SH and Bantam Pulverizers: Schutz-O'Neill Mills.
Charlotte #3 Monel Colloid Mill.
Eppenbach V9 Aloxite Colloid Mill.
Day, Robinson, Tyler Hum-mer, Great Western, Gayco, Raymond Sifters.
Rotex Sifters—40½" x 120" and 40" x 84".

MISCELLANEOUS

Podbelniak 6080 S. S. Solvent Extractor.
Oliver, Sweetland #2, Sparkler, Sperry, Shriver, Alsop Filters.

OVER 5,000 MACHINES IN STOCK—INSPECTION INVITED

Complete Details and Quotations Available—Write Today!

UNION STANDARD EQUIPMENT CO.
318-322 Lafayette Street New York 12, N. Y.

TOP PRICES PAID FOR YOUR SURPLUS EQUIPMENT

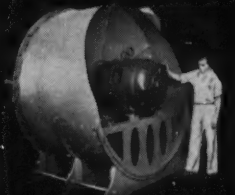
NEW AND GOOD-AS-NEW EQUIPMENT

1—Stainless Tank #430 Chrome, vert. 7'x10' deep.
20—Jacketed Kettles—Stainless, Copper, Aluminum.
1—Day Mixer, steam jacketed, 50 gal. Sigma Blade.
1—Copper Evaporator, steam jacketed, 9'1"x3'9".
60—New Pressure Cookers, 18"x18" & 24"x28".
150—Pumps—steam and electric.
1—New Glass Nash Centrifugal Pump, 160 gpm.
1—New Nash Vacuum Pump Type AL-572.
1—Buflovak Jacketed Impregnating Tank 42"x52".
1—Stedman Disintegrator size 40-6.
1—Abbe Ball Mill, 36"x42" Buhrstone lined.
#316 Stainless Steel Tanks, new 100, 200 & 300 gal.
1—Nash Air Compressor, Type AL-623.
1—Manton Gaulin Stainless Homogenizer 125 gph.
1—I&R Vacuum Pump, 5 H.P., 60'.
4—Heat Exchangers, 12" dia. 11' lg., 43 steel tubes.
1—Stokes Single Punch Tablet Machine.
1—Raymond 8" Hammer Mill, like new.
Davenport Rotary Steam Tube Dryer, 6'x36'.
2—Stainless Steel Steam Jacketed Readco Mixers.
1—#316 Stainless Reactor, 265 gals. cap., jacketed.
Abbe Pebble & Tube Mill, 5'x22"—Buhrstone Lined.
1—Patterson Ball Mill, porcelain lined, 17"x27".
1—Patterson Ball Mill, 42x36, jacketed.
45—Steel Tanks from 100 to 100,000 gals.
2—Large Steam jacketed Horizontal Mixers.
Robinson Pulverizer #20, with 2 motors 10 HP each.
2—Ribbon Type Mixers 50 & 90 cu. ft.—like new.
4—Horizontal Retorts 200# w.p., A.S.M.E. from 12" to 24" dia., 4' to 12' long.
2—Crystallizers—10' long.
3—3,000 gal. jacketed Kettles with Turbo Agitators.
1—#10 Day 300 gal. jacketed Sigma Blade Mixer.
4—new Heat Exc. 60' with Cupro Nickel Tubes.
1—Sparkler Stainless Filter Model 33-S-9.
3—2500 gal. Pfaudler G/L Tanks & S/S Agitators.
6—Blackburn-Smith Jacketed Filters, 20 to 160 gpm.
1—Jeffrey Vibrating Conveyer, 15' long.
4—Hoffman Steam Jacketed Filters.
1—Meade Mill #2 with 7½ H.P. Motor.

H. LOEB & SON :-: 4643 LANCASTER AVE., PHILADELPHIA 31, PA.

New and Rebuilt

FANS—BLOWERS EXHAUSTERS



Save 30% to 50% on Stock Shipments

We can supply all leading makes of — Rotary Positive Blowers . . . Turbo Blowers . . . Centrifugal Fans . . . Steel Plate Exhausters . . . *fully guaranteed.* Whether you need 1 cu. ft. of air or 100,000 we have the blower to do it. We have had 28 years of exclusive rebuilding experience on this type of equipment.

WRITE OR WIRE

Send us your requirements or write for complete listings.

WM. W. MEYER & SONS
8243 Elmwood Avenue
SKOKIE, ILLINOIS
Chicago Phone: Independence 3-5127

LOOK

WHEN EVERY DOLLAR COUNTS

2—UNUSED No. 12 Sweetland Filters, 48 bronze monel covered lvs. 3" cc.
2—8'x125' Rotary Kilns.
3—6'6"x50' D. H. Rot. Dryers, ⅝".
1—#2 Simpson Mixer, motor drive.
2—54"x70" and 1—40"x60" Bird Continuous Centrifugals, S/S Solid bowls.
2—S/S Hersey Rotary Dryers, 5x26' and 6'x23'.
1—#502-16 Link Belt S/S Roto-Louvre Dryer.
1—3'x50' Bonnet D. H. Rotary Dryer & Cooler.
3—6'6"x50' D. H. Rot. Dryers.
1—50 gal. Stainless 347, Calandria Still, Agitated, with Condenser.
1—50 Gal. Stainless 347, Agitated Tank, Motor Driven.
9—Sperry 18"x18 iron recessed Filter Presses, 18 chambers.
3—450 gal. S.S. Steam Jktd. Kettles.
1—Buflovak 48"x40" Drum Flaker, chrome plated, S/S ends.
1—Oliver Rotary Acid Filter, 6'x6'.
4—Mojonnier, S.S. Vav. Pans, 3', 5', 6'.
3—6'x50' L'ville Rot. Tube Dryers.
1—Day size 30 Imperial Jacketed 75 gal., Sigma Blades.
1—4TH, Mikro Pulverizer, 60 H.P., t.e.f.c.
4—Buflovak Atmo. Dbl Drum Dryers 24"x36", 32"x90", 42"x120".
3—Anco 4'x9' Chilling Rolls.
5—Horiz. Ribbon Dry Mixers, 4000 lb., 1500 lb., 500 lb.

Only a Partial Listing

Wanted: Your Idle Machines or Plants
Send List Today

CONSOLIDATED PRODUCTS COMPANY, INC.
Our 39th Year
154 Observer Highway, Hoboken, N.J.
Tel.: HO 3-4425 N. Y. Tel.: BA 7-0600

We challenge you to BEAT BRILL VALUES!

DRYERS

1—Vulcan 8'x125' Rotary Kiln.
2—Vulcan 6'x40', 4½'x50' Rotary.
1—Link Belt 5'2"x20' Roto-Louvre.
4—Devine #27 double door Vacuum Shelf, 17—59"x78" shelves.
1—Struthers-Wells 5'x15' nickel Rotary Vac.
3—Buflovak double drum 42"x120", 42"x90", 32"x90".
2—Hersey 3'x15', 1½'x12', 304 S/S.

FINAL LIQUIDATION

Baton Rouge, Louisiana

1—I.R. Jet Refrigeration Unit complete 208 tons 65° to 60°F.
1—Patterson 7'6" Conical Blender rubbed lined.
1—Buflovak 6'x5'6" Monel Drum Flaker, NEW.
1—Pfaudler 250 gal. Hastelloy "C" Reactor.
3—4'x13' closed 316 S/S Reactors, 109—3'6", 316 S/S tubes, 150 psi.
1—2500 gal. 316 S/S jacketed Reactor.
1—Pfaudler 5'x18' Horiz. glass lined 2500 gal.
1—7500 gal. 316 S/S clad 12'x6'x5'6" cone.
3—Link Belt 316 S/S 18"x 12", 18"x10', 18"x7' Twin Conveyors.
200 ft. 18" Troughing Belt Conveyor with housing.

FILTERS

2—Oliver Rotary, Monel 8'x10', 3'x2'.
1—Feinc 5'x7' S/S Rotary Vac.
1—Feinc 5'x3' Monel, Rotary Vac.
3—Eimco 18"x24", 18"x12", 316 S/S Rotary Vac.
2—Sweetland #12, 72 and 36 leaves.
2—Sweetland #3, 75 sq. ft., 304 S/S.
1—Niagara 53 sq. ft., 304 S/S.
1—Shriver 42" P&F, 40 chambers, wood.
2—Shriver 30" P&F, 30 chambers, iron.

PULVERIZERS—CRUSHERS

2—B&J #1½, #2 Rotary Cutters.
4—Hardinge Mills 4½'x16", 6'x22", 7'x36".
1—NEW Patterson 6'x8' porcelain Pebble Mill 50 HP.
1—National 6"x12" Plastic two-roll Mill.
1—Mikro Pulverizer #1SI, 304 S/S.

CENTRIFUGALS

1—AT&M 40" Suspended, rubber perforated.
1—AT&M 40" Suspended, steel.
1—Bird 40" Suspended, rubber.
3—Tolhurst 40", 32", 26" Suspended, steel.
1—AT&M 36" center-slung, rubber.
1—Fletcher 30" center-slung S/S.
1—Fletcher 20" Suspended, 304 S/S.
2—Bird 32"x50", 36"x50" steel, solid bowl Continuous.
2—Bird 18"x28" solid bowl, 310 S/S.
2—Sharples #C-27, #C-20, S/S Super-D-Hydrators.

SCREENS

4—Rotex double and single deck 40"x 120", 40"x84".
3—Robinson single deck 40"x84", S/S.
3—S. W. single deck 40"x84", S/S.

MIXERS

8—Day "Cincinnatus" double arm Sigma Blade 550, 200 and 100 gal.
2—Baker Perkins 100, 50 gal. Sigma Blades, jacketed.
2—Robinson 90 cu. ft. 316 S/S jacketed powder.
9—Steel jacketed Powder 50, 225, 265, 350 cu. ft.
1—Robinson 4000# steel Powder.
6—Rodgers 400 to 3000# Powder.
1—Simpson Intensive Mixer #0.
8—NEW Portable Agitators ¼ to 5 HP.
4—Day, Ross 8 and 50 gal., Pony.

TOWERS—REACTORS CONDENSERS & TANKS

2—8'x12' Vertical Tanks 347 S/S 5,000 gal. ½" shell, 120# W.P.
4—Steel Storage Tanks 10'x40', 10'x30', 8½'x25' Horizontal.
8—Towers 7'x25'6", 347 S/S, 6'x83', 6'x34', 5'x96', 30"x70', 24"x42', 12"x 30', 8"x20'.
1—10,000 Aluminuum Storage Tank 10'x16'x½" shell, 25# W.P.
4—Foster Wheeler Karbate Heat Exchangers 188 sq. ft.
1—Struthers-Wells 536 sq. ft. S/S Heat Exchanger.
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1—6'x34' Vacuum Tower 150#.
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6—Steel Bldgs., 20x150, 12x 20, 20x40.

MISCELLANEOUS

2—Lawrence 5" Hastelloy "C" Centrifugal Pumps.
8—Nash Vacuum Pumps, #H-7, #H-6, #4, #2, #L5, #L3, #MD571.
2—Beach-Russ #50D Vacuum Pumps, 50 cfm.
20—Durimet, Olivite 316 S/S Duriron Centrifugal Pumps 1" to 3".
10—Centrifugal Pumps 60 to 2000 gpm, motor driven.
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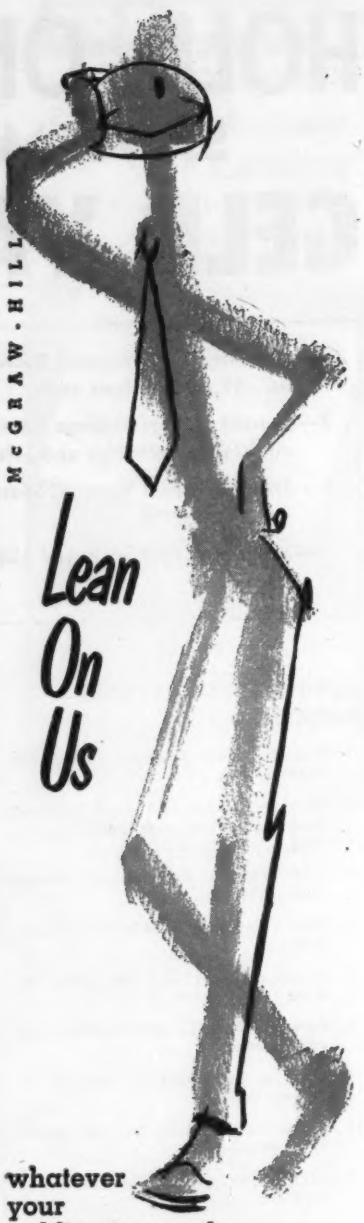

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MAY, 1956

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- **Products listed feature code numbers which show the page on which they appear. L (left), R (right), T (top), B (bottom) indicate ad location; A, B, C, etc. and a, b, c, etc. identify specific product items on an editorial page or in an ad.**
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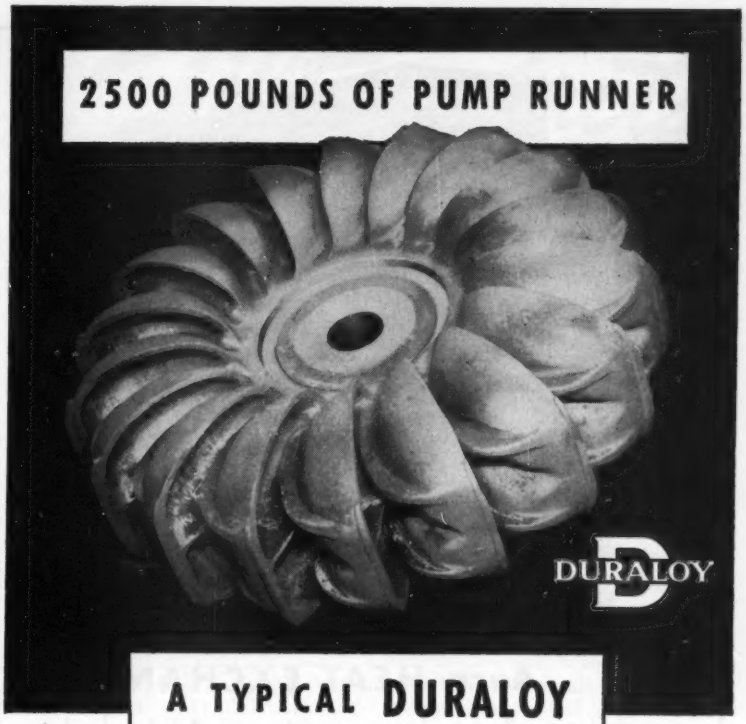

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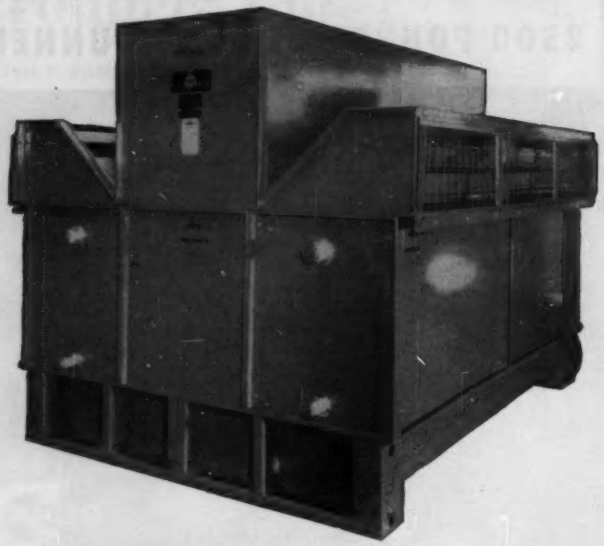

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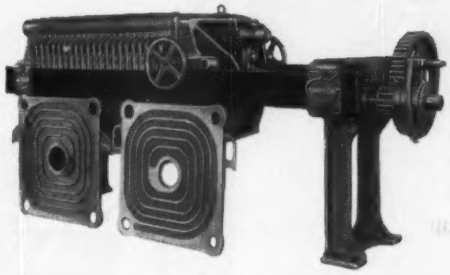

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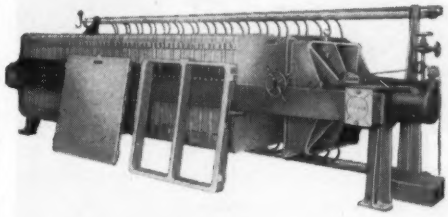

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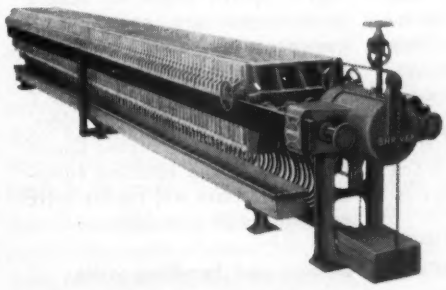

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Bulletin 127

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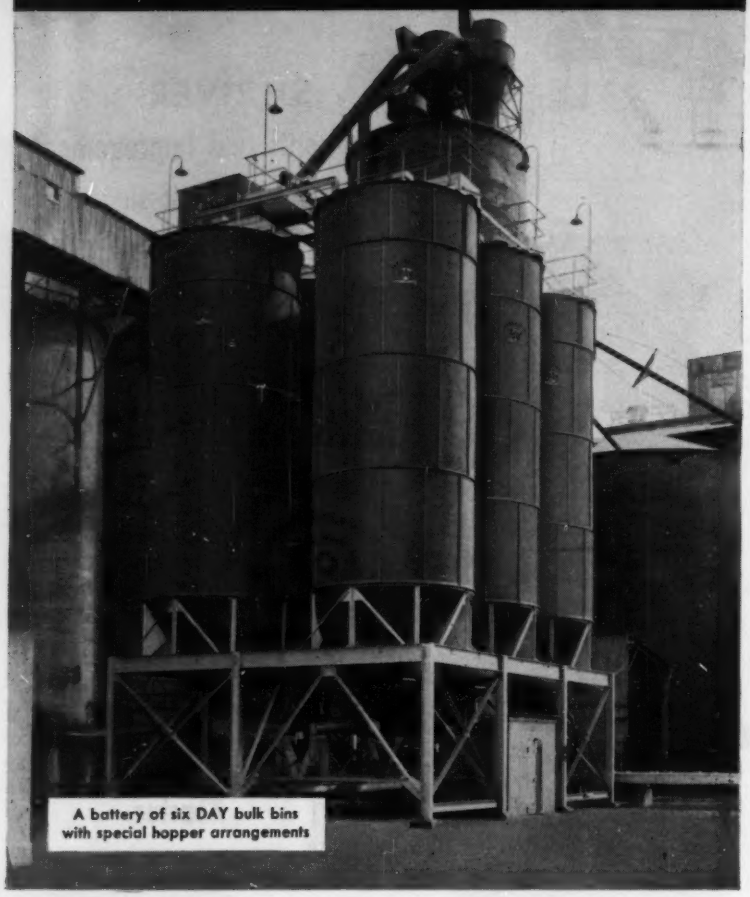

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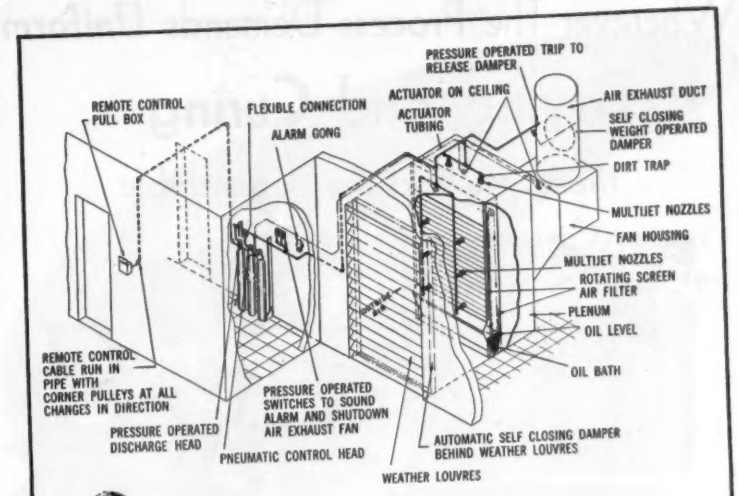

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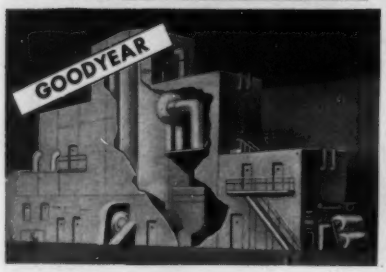

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436A Eastman Chem. Products.

Acetoacetarylamides.....Furnishes technical information on company's line of acetoacetarylamides. Includes physical properties, applications, physiological properties, etc. Request literature reference, No. F-8259.
436B Carbide & Carbon Chem.

Acid, Ascorbic.....The antiscorbutic vitamin . . . antioxidant in food industry . . . reduces smoking time, improves cure color, retards fading in cooked & cured meat products, etc. Technical Information Sheets.
436C Mallinckrodt Chem. Wks.

Acid, Adipic.....Comprehensive 8 p. reference gives physical & chemical properties; principal reactions on the carboxyl & alpha methylene groups; solubility curve, & suggested uses; etc. Technical Bulletin 1-12.
43 *National Aniline Div.

Acid, Chromic.....72 p. Handbook covers chromic acid & its many metal-finishing applications. Subjects discussed range from physical & chemical properties to chromium plating formulas, specifications & equipment.
436D Diamond Alkali Co.

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384 Harshaw Chem. Co.

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436M Diamond Alkali Co.

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436N Westvaco Mineral Products.

Chemicals, Molybdenum.....Molybdenum compounds are widely used in production of catalysts, phosphomolybdic-phosphotungstic lake colors, molybdate chrome orange pigments, etc. Technical data, samples, prices.
436O J. T. Baker Chem. Co.

Chemicals, Molybdenum.....Company announces the availability of an informative reprint covering their product line . . . a commodity review on production and uses of molybdenum chemicals. Bulletin No. Ch-7.
436P Climax Molybdenum Co.

Chemicals, Organic, Synthetic.....1956 edition of "Physical Properties . . . Synthetic Organic Chemicals" includes data on: alcohols; aldehydes; acids; esters; glycols & triols; ethers & oxides; etc. 24 p. Ref. F-6136-1.
436Q Carbide & Carbon Chem.

Chemicals, Peroxygen.....Modification methods based on the use of hydrogen peroxide, peracetic acid, and persulfates are described in detail. Also contains numerous literature references. Bulletin No. 27.
436R Buffalo Electro-Chem. Co.

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436S Carbide & Carbon Chem.

Diisocyanates, Aromatic.....New plant nearing completion at Moundsville, W. Va. will help polyurethans to achieve their destiny as "America's next great synthetic". "Product-data package" of Bulletins.
223 *National Aniline Div.

Elastomers.....Neoprene and Hypalon elastomers are used in improving products and cutting maintenance and replacement costs. Company offers "Neoprene Notebook" and "Facts about Hypalon".
39 *E. I. DuPont de Nemours.

Furfural.....16 p. devoted to physical data on QO brand, including recovery of furfural from various systems, vapor pressure graph & temperature-composition diagram of furfural-water. Bulletin 203-A.
436T Quaker Oats Co.

Glutaraldehyde..... Glutaraldehyde, a highly reactive derivative of acrolein, is supplied as a stable, aqueous solution having a mild odor and a light color. Literature includes physical properties. No. F-40005.
436U Carbide & Carbon Chem.

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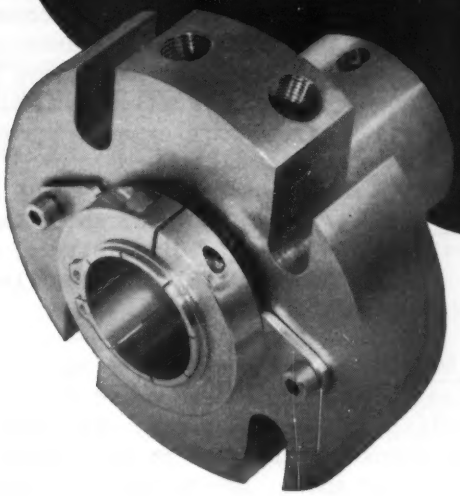

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41 *Heyden Chem. Corp.

Hydrogen Peroxide.....New 24 pg. book on hydrogen peroxide contains sections on physical properties, chemical reactions, uses, containers, handling and storage. For details, request your copy.
145 *Solvay Process Div.

Hydrogen Peroxide.....Supplies valuable article reprint, "History of the Hydrogen Peroxide Industry" . . . a review of the manufacture and use of hydrogen peroxide. Request your copy of Bulletin No. 50.
438A Buffalo Electro-Chem. Co.

Inositol.....Long recognized as a member of the Vitamin-B complex & an important lipotropic agent, it has been included in the new edition of the National Formulary. Abstracts cover the recent literature.
438B Corn Products Refining Co.

Latices.....New Bulletin describes Chemigum Latex 236 and 246: the two main particulars, particle size and stabilization, which make them different from other latices; and an analysis of their properties.
438C Goodyear Tire & Rubber Co.

Latices.....Presents a new 16 p. reference on use of Hycar latices in textiles. Features a chart showing the physical properties of Hycar latices & typical fields of application for each. Request Service Bulletin H-20.
438D B. F. Goodrich Chem. Co.

Lithium Aluminum Hydride.....A specific agent for numerous organic reductions. Reference gives composition, properties, solubility, applications, typical reductions, handling, safety & storage data. Bul. 401-D.
438E Metal Hydrides.

Magnesium Aluminum Silicate, Colloidal.....Literature includes: physical properties: chemical analysis; preparation, viscosity, and properties of Veegum water dispersions; applications; etc. Bulletin 122.
438F R. T. Vanderbilt Co.

Magnesium Stearate Purified.....A fine, white powder; odorless. Uses—a covering agent, a dry lubricant, bodying agent, gel-breaker and emulsifier. Descriptive Technical Information Sheet is available on request.
438G Mallinckrodt Chem. Wks.

Molybdenum.....Announces the release of product literature, "Climax Methods of Analysis." Features analytical procedures for the determination of molybdenum and the impurities in various molybdenum compounds.
438H Climax Molybdenum Co.

Monomers.....Vinyl propionate monomer clears the way for the commercial development of **new emulsion paints**, adhesives, laminates, etc. Available in drum lots to tankcar quantities. Samples & Bulletin.
71 *Celanese Corp. of Amer.

Monopentaerythritol.....Issues upon request a new Technical Bulletin on "Monopentek," Heyden's monopentaerythritol. Includes data on specification, properties, solubility, reactions, uses, etc. Bulletin PE 11-55.
438I Heyden Chem. Corp.

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121 *Nitrogen Div., AC&D.

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143 *Commercial Solvents Corp.

* From advertisement, this issue

Oils & Waxes, Fluorocarbon.....Illustrated 20 p. booklet contains detailed information on KEL-F fluorocarbon oils, waxes and greases: chemical structure; specifications; applications; properties; etc.
439A M. W. Kellogg Co.

Pentachlorophenol.....Essentially a laboratory manual, valuable booklet gives detailed instructions for detection of penta, its sodium salt, & certain closely related phenols. Technical Bulletin No. 0-24.
439B Monsanto Chem. Co.

1, 5-Pentanediol ..... Makes available technical information on 1, 5-pentanediol (pentamethylene glycol). Includes physical properties, net container contents, reactions & applications, etc. Reference No. F-40006.
439C Carbide & Carbon Chem.

Perchlorethylene.....6 p. Folder describes Diamond perchlorethylene for professional drycleaning at its best, outlines advantages it gives to drycleaners; also includes physical properties of this new solvent.
439D Diamond Alkali Co.

Peroxide Bleaching Processes.....Three Becco peroxide bleaching processes which are of prime utility for bleaching, superbleaching and prevention of reversion of Southern woods are described in Bulletin No. 65.
439E Buffalo Electro-Chem. Co.

Phenobarbital USP Powder.....An odorless, white powder having a somewhat bitter taste. Uses—a sedative, hypnotic and antispasmodic in human and animal treatment. Full details in Technical Information Sheet.
439F Mallinckrodt Chem. Wks.

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439G Dow Chem. Co.

Pigments, Molybdate.....Valuable reprint entitled, "Evaluating Molybdate Pigments as Corrosion Inhibitors," discusses possible use of slightly soluble molybdates in white and tinted inhibitive paints.
439H Climax Molybdenum Co.

Piperazines & Pyrazines.....A literature survey covering the reactions and applications of these compounds. Pertinent data extracted from 177 sources provides a quick review of their chemistry. 33 p. booklet.
439I Wyandotte Chem. Corp.

Potassium Acetate, N.F., Crystal, Technical.....Offers an informative Data Sheet which gives pertinent details concerning physical and chemical properties, suggested uses, containers, etc. No. DA-40821.
439J Baker & Adamson.

Potassium Borohydride.....Detailed reference gives composition, properties, solubility, applications, typical reductions, handling, safety and storage information. Request copy of Technical Bulletin No. 301-B.
439K Metal Hydrides.

Resins, Coating.....New booklet covers Plaskon urea & melamine coating resins for modern industrial baking enamel systems. Presents complete properties of these resins together with recommendations for use. 12 p.
439L Barrett Div.

Resins, High Styrene.....Darex 43G is an excellent rubber reinforcing resin for shoe soles, floor tiles, wire & cable insulation, mechanical molded goods. Characteristics, features, etc., in Brochure No. C-15.
439M Dewey & Almy Chem.

Resins, Ion Exchange.....New Nalco bulletin gives technical data on Nalcite SAR & SBR anion exchangers... including complete up-to-the-minute information on silica removal. Request your copy. Bulletin No. 57.
302 *National Aluminate Corp.

* From advertisement, this issue

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No matter how attritionized the product, this new Prater Blow-Thru Feeder will feed it efficiently and quickly into any pneumatic system. And this new design becomes an integrated part of the pipe line and will feed against pressures as high as 10 PSIG . . . either positive or negative!

One of the efficient design features of this unit is that on the horizontal center line of the body casing is a pressure neutralizing port to bring the rotor pockets to atmospheric pressure before filling.

There are many other interesting and high quality production features. Power requirements vary according to the fineness and abrasiveness of the product . . . flour, salt, carbon or any other material.

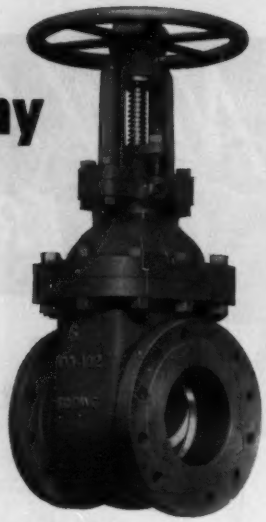
Available in cast iron and bronze . . . write today. Ask for our new airlock catalog, the most comprehensive in the industry!

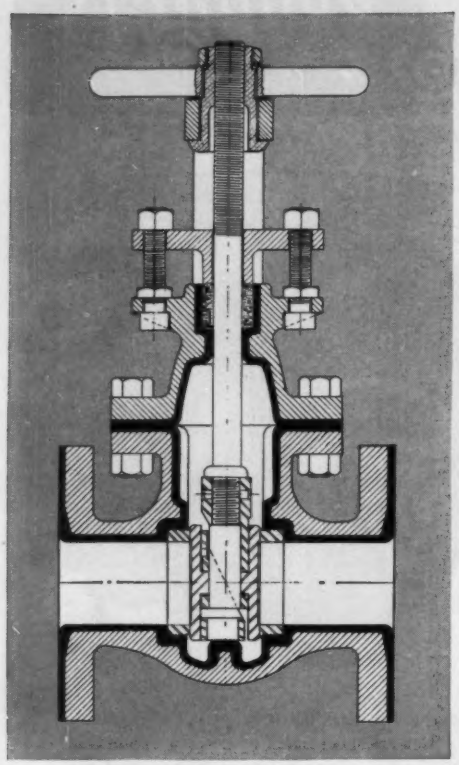
FREE!

PRATER PULVERIZER COMPANY

1517 S. 55th Court
Cicero, Illinois

FOR double economy in corrosive service





• *Darling rubber-lined iron body gate valves, with special alloy working parts, offer trouble-free corrosive service and big savings. Available in rising stem, cylinder or motor operated, or quick-opening types.*

HERE'S a Darling gate valve that can save you plenty of dollars in corrosive services up to 180° F. This is an iron body valve with a hard rubber lining permanently bonded to all exposed interior surfaces, and suitable for working pressures up to 150 pounds.

Equally important, this valve features Darling's *fully revolving double disc parallel seat principle* which is unexcelled for trouble-free performance, tight closure, low maintenance and long life.

Weigh these facts and potential savings, then write for complete data on these job-proved rubber-lined iron body valves.

DARLING VALVE & MANUFACTURING CO.
Williamsport 3, Pa.
Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

DARLING VALVES

LITERATURE . . .

Resins, Polyester.....Atlac 382 plastic features a superior combination of low weight & high strength, dimensional stability & excellent flow characteristics. Bulletin covers properties & chemical resistance.
440A Atlas Powder Co.

Resins, Polyethylene.....Tough, flexible Alathon polyethylene resin stands up well against abrasive slurries. Widely used in industrial pipe applications. Offers complete information on the properties and applications.
221a *E. I. du Pont de Nemours.

Resins, Polyvinyl Chloride.....Describes Marvinol VR-30, a new & unique polyvinyl chloride resin designed especially for the calender industry. Covers properties, compounding & processing. Bulletin No. 2.
440B Naugatuck-Chem. Div.

Resins, Polyvinyl Chloride.....Multigraphed Data Sheet lists physical properties of Diamond PVC-45 polyvinyl chloride resin, & cites its advantages for calendering of film & sheeting & other applications.
440C Diamond Alkali Co.

Resins, Polyvinyl Chloride.....Scrupulous attention to purity produces polyvinyl chloride resin that can be fabricated with complete confidence. Literature and product samples of Vygen available on request.
440D General Tire & Rubber Co.

Resins, Styrene-Butadiene.....Maintaining color uniformity is no longer a problem with masonry paints based on Pliolite S-5, Styrene-Butadiene resin. See "Color Uniformity of Pliolite S-5 Finishes," Ref. No. 55-274.
440E Goodyear Tire & Rubber Co.

Resins, Synthetic.....Illustrated, 24 p. "Resin Review" (No. 15) includes sections on: Acryloid B-66, Amberlac 292X and Uformite MM-47 specialty coating resins; polyester-urethane foams; resin reactivity; etc.
440F Rohm & Haas Co.

Resins, Tetrafluoroethylene.....Teflon tetrafluoroethylene resins used extensively in process industries. Offer chemical inertness, high heat resistance, low-temperature toughness, etc. Properties & applications.
221b *E. I. du Pont de Nemours.

Soda, Caustic.....''Caustic Soda Buyer's Guide'' contains helpful facts on economics of 50% & 73% solutions; other forms of caustic soda; capacities of tank cars & other containers; useful shipping data; etc.
378e *Hooker Electrochem Co.

Sodium Carbonate Peroxide.....Company announces the availability of literature describing the product line. Included are chemical and physical properties, uses and handling. Request Bulletin No. 6.
440G Buffalo Electro-Chem. Co.

Sodium Carboxymethylcellulose.....Detergency-grade Carbose is a special CMC for promoting home & commercial soaps & detergents. Makes available valuable technical information & product samples of Carbose.
440H Wyandotte Chem. Corp.

Sodium Sulfate.....West End Chemical now is producing salt cake and anhydrous sodium sulfate at the rate of approximately 50,000 tons annually. Makes available upon request product samples and detailed literature.
280 *West End Chem. Co.

Sodium Sulfhydrate.....Hooker sodium sulfhydrate dissolves rapidly, even in cold water. There's virtually no sedimentation even after long standing. Available in 90-lb. & 350-lb. drums. Technical Data Sheet.
378b *Hooker Electrochem. Co.

Sodium Sulfide.....The clean, strong flakes dissolve right into process, even without stirring. No waiting . . . no decanting. For complete information on Hooker's sodium sulfide, request Technical Data Sheet.
378a *Hooker Electrochem. Co.

* From advertisement, this issue

Sodium Sulfite Anhydrous Photo Granular .....Fine, white, free-running crystalline granules; odorless. Chiefly used in photographic developing and fixing solutions. Details in Technical Information Sheets.
441A Mallinckrodt Chem. Wks.

Sulphuric Anhydride, Stabilized.....Sulfan has 99.5% SO_3 available for sulfonation reactions. In many applications, this means considerable savings in operating costs. Request complete technical information.
117 *General Chem. Div.

Surfactants.....Igepons are important in many industries, including cosmetics, textiles, detergents, paper, leather, agricultural and industrial chemicals, to improve a product or process. Request information and samples.
273 *Antara Chem.

Waxes, Petroleum.....Cardis One is one of the many new waxes developed by Warwick to provide manufacturers with formulations that answer the growing consumer demand for wax-rich polishes. Data & samples.
441B Warwick Wax Co.

Construction Materials

Alloys.....Hastelloy alloy D has excellent resistance to sulphuric acid in all concentrations and at temperatures up to the boiling point. Announces availability of a booklet which describes Hastelloy product line.
227 *Haynes Stellite Co.

Cements, Insulating....Eagle-Picher One-Cote cement insulates, protects, finishes in one quick application. Cement is clean, easy to handle—provides a smooth, light-reflectant surface. Request free sample.
37 *Eagle-Picher Co.

Coatings, Protective.....A new 12" by 18" comparative guide form blank available for your use in comparing coating systems. Shows method to arrive at cost per sq. ft. per year of service for each system considered.
441C Carboline Co.

Coatings, Protective.....Describes application of Sprayed Metal Coatings to processing equipment, storing & shipping containers, tanks, tank cars, etc. for contamination & corrosion protection. Illustrated.
441D Metalweld, Inc.

Coatings, Protective.....Phenoline 305 for heavy duty maintenance protection in severe corrosive atmosphere needs only 2 coats. Complete data is available & also comparative data chart.
303 *Carboline Co.

Coatings, Protective.....Describes Amercoat No. 87—a heavy bodied, high solids vinyl resin coating which can be applied at thicknesses up to 10 mils in one coat. General physical & chemical properties detailed.
231 *Amercoat Corp.

Coatings, Protective.....Literature Folder includes booklets on: Rowe's Polyvinate Coating System; Rowe's Neoprene Coating System; Rowe's Asphalt Coating System; Rowe's Rocrolite Coating System; etc.
441E Rowe Paint & Varnish Co.

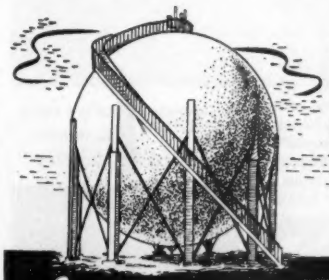
Coatings, Protective.....The "Amercoat 33/86 System" has proven amazingly helpful . . . to control corrosion where only minimum surface preparation is possible. For details, request descriptive literature.
441F Amercoat Corp.

Fabrication.....Foster Wheeler's exceptional facilities for heavy fabrication can solve your toughest forming, machining and welding problems. Details on fabricating facilities in Bull. GS-56-4.
88 *Foster Wheeler Corp.

* From advertisement, this issue

There is a competent Aerofin heat-transfer engineer near you—qualified by intensive training and long experience to find the *right* answer to your own particular heat-exchange problem—and backed by the research and production facilities of the pioneers in light-weight extended surface.

Ask the Aerofin Man.



Throughout the Chemical Industry—

Aerofin units do the job Better, Faster, Cheaper

AEROFIN CORPORATION
109 Greenway Ave.
Syracuse 1, N. Y.

Aerofin is sold only by manufacturers of fan-system apparatus. List on request.

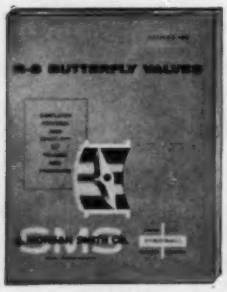
NOW YOU CAN SPECIFY STANDARD R-S BUTTERFLY VALVES FOR FASTER DELIVERY

R-S BUTTERFLY VALVES

When the delivery date is important, you can get faster service on standard R-S Butterfly Valves. Based on the results of previous experience, R-S Valves are now standardized. All components for those most commonly used, in sizes from 4" to 48", are carried in stock, ready for assembly.

R-S Butterfly Valves give you positive, dependable performance. You get the advantages of:

- complete control in all positions of normal regulating range.
- fast regulation and closure.
- minimum pressure drop that saves power.
- compactness and light weight at less cost.



This new catalog will give you complete dimensions, specifications, layout drawings and materials for all R-S Butterfly Valves in the pressure ratings that have been standardized to date. As others are added, new sections will be published. To get a free copy and assure yourself of future sections, contact your SMS representative, or write to S. Morgan Smith Company, York, Pennsylvania.

HYDRAULIC TURBINES · GATES & HOISTS · TRASH RAKES · PUMPS · ACCESSORIES

HYDRODYNAMICS

ROTOVALVES · FREE-DISCHARGE VALVES · BALL VALVES · CONTROLLABLE-PITCH SHIP PROPELLERS · BUTTERFLY VALVES

S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED • TORONTO

LITERATURE . . .

Fabrication, Plate.....Illustrated, 12 p. covers dozens of typical examples of plate fabrication work done by the company for chemical, refining, petrochemical, food and other process industries. Request Bulletin PF.
14 *Downingtown Iron Wks.

Fabrication, Specialty.....Presents fully illustrated brochure of fabricating facilities of a company which specializes in engineering and fabrication of specialty and custom-built equipment. Request Catalog No. 155.
442A Fritz W. Glitsch & Sons.

Insulation, Cellular Glass.....Gives you the maintenance-free insulating performance you need for your piping, tanks, spheres and other industrial equipment. Request product booklets & "Foamglas" sample.
391 *Pittsburgh Corning Corp.

Insulation, Industrial.....No matter where your insulation job may be—Armstrong can give you efficient, well-integrated, on-the-job service from original specs to final installations. Booklets describes full line.
215 *Armstrong Cork Co.

Insulation, Pipe.....Lower heat losses, lower cost with new Snap*On glass fiber pipe insulation. Available in sizes that will fit pipe from ½" to 33" nominal diameter, inclusive. Request Technical Bulletin SO-55.
347 *Gustin-Bacon Mfg. Co.

Linings, Rubber.....Acid-proof rubber linings protect equipment and processes against corrosion and abrasion. Additional data will be found in Tank Lining Catalog No. 7115.
356 *Raybestos-Manhattan.

Materials of Construction.....Describes five materials of construction, unique in their high resistance to corrosion: porcelain; stoneware; coatings; graphite; & alumina. Details in Bulletin No. CHE-R5.
442B General Ceramics Corp.

Molding Materials.....Containing 25 case histories, illustrated "Design File" serves as a convenient handbook for evaluation & use of G.E.'s rubber-phenolic molding materials. Reference No. CDC-237A.
442C General Elec. Co.

Paints, Aluminum.....Put a protective shield on rustable metal & masonry surfaces—resist corrosion from fumes & smoke—seal against moisture & rust—reflect light & heat—etc. Descriptive literature.
310 *Reynolds Metals Co.

Paints, Protective.....Tygorust & Tygon "ATD" are companion products to make your fight against corrosion less costly—more effective. You can get better protection . For the full story, write for the TYGON Manual.
102 *U. S. Stoneware.

Plastics.....“Packaging with Plastics" offers case histories of successful packaging applications, technical data on basic resins & new & unusual ideas on use of Bakelite plastics in the packaging field.
442D Bakelite Co.

Refractories.....Carborundum has pioneered scores of super refractories with a wide variety of properties to meet your most demanding requirements. For complete details, request Refractories Booklet.
263 *Carborundum Co.

Sheet, Stainless.....It has been estimated that 50% of stainless sheet applications could employ type 430. Request a copy of "Care & Use of 430 MicroRold Stainless Steel" for information.
34 *Washington Steel Corp.

Steels, RubberLined..... Ace rubber-lined steel . . . strength & pressures of steel plus chemical resistance of hard rubber. Excellent for alkalis, most inorganic acids, many organic acids, etc. Bulletin CE-52.
315b *American Hard Rubber Co.

* From advertisement, this issue

Steels, Stainless.....Makes available valuable reference, "AL Stainless Steel in Chemical Processing"—36 p. on various applications, advantages, etc. of stainless in the chemical industry. Request your copy.
443A Allegheny Ludlum Steel Corp.

Steels, Stainless ..... Covers superior stainless steel sheets, strip, bars plates, wire, forgings, etc. Data in informative 44 p. booklet, "Making the Most of Stainless Steels in the Chemical Processing Industry."
25 *Crucible Steel Co. of America.

Titanium....."Facts About Titanium" contains a list of commonly available titanium alloys & their compositions, forming & welding methods, heat treatment & machining data, current & projected prices, etc.
443B Arthur D. Little.

Titanium Sponge.....Resists chlorides & other corrosive chemicals as no other structural metal can. Offers general booklet on titanium plus new technical bulletin with data on corrosion-resistant properties.
31 *E. I. du Pont de Nemours.

Electrical & Mechanical

Belts, V Information on line of sealed-life V-belts is offered in bulletin. Construction details and complete data on size, pitch lengths and outside lengths. See Bulletin A606.
306-7c *Dodge Mfg. Corp.

Chain, Roller.....Adaptable to power transmission or conveying. Positive, flexible, economical chain with high sustained efficiency. Lock-type bushings result in long roller chain life. 148 p. Data Book 2457.
65 *Link Belt Co.

Drives ..... Describes the Cleveland Speed Variator—a simple, compact drive that provides infinitely variable output speed over a range up to 9:1 from a constant speed power source. Illustrated Bulletin K-200.
12 *Cleveland Worm & Gear Co.

Drives, Adjustable Speed.....New illustrated folder describes the "Ampli-Speed" Magnetic Drive . . . which provides precise, adjustable speed power for a wide range of applications. Bulletin 4400-PRD-229.
443C Electric Machy. Mfg. Co.

Drives, Control.....New, small, piston-operated Bailey Control Drive will improve flow characteristics of butterfly valves, dampers, hydraulic couplings, feeders, etc. Specs. Nos. P81-1 and P81-5.
94 *Bailey Meter Co.

Drives, V-Belt.....Issues 74 p. booklet carrying handy multi-color tables for quick & easy selection of constant speed "Texrope" V-belt drives. Also covers design features, basic drive principles, etc. Tex-Book 20P40.
443D Allis-Chalmers Mfg. Co.

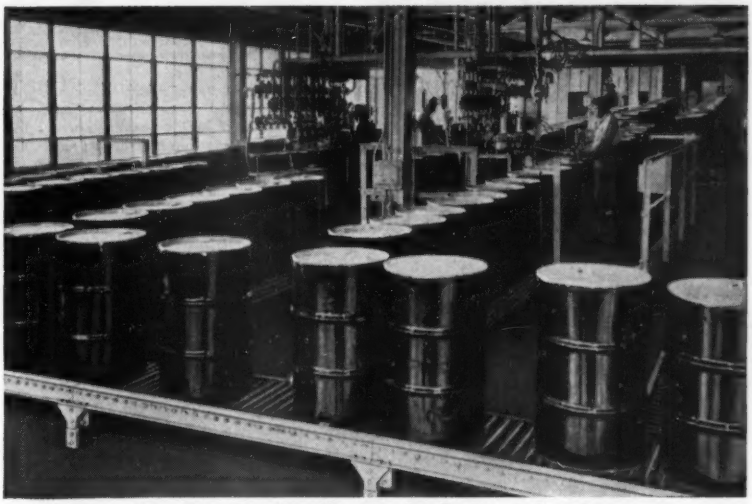
Drives, Valve.....Designed to meet the needs of oil, gas, chemical, water, sewage, and other types of installations. Twelve assembly positions are available, with standard gear ratios. Brochure.
26-7 *Janette Electric Mfg. Co.

Enclosures, Pushbutton.....Describes the new Hoffman oil tight pushbutton enclosures. Includes: application; types available; mounting; construction; back mounted contact blocks; finish; specifications; etc.
443E Hoffman Engrg. Corp.

Gaskets & Adaptors.....U. S. Gasket Company offers free literature on their Chemiseal Snap-on Type 820 Gaskets and Adaptors No. 2-CRS. Write now for Catalog No. TG-953.
319b *U. S. Gasket Co.

* From advertisement, this issue

Ask Standard ... how to cut costs with conveyors



Live roller and gravity roller system handles 55 gal. drums from storage through filling and weighing operations to shipping.

No manpower needed to keep heavy drums moving

STANDARD conveyor systems keep heavy, bulky commodities moving with minimum manpower and time loss. Systems can be job-tailored to any specific materials handling problem — to meet almost any needs.

With more than 50 years of experience in conveyor application, Standard engineers are qualified and ready to help solve your handling problems. Standard builds permanent or portable systems and units, using roller, belt, slat, chain, push-bar or sectional conveyors — power or gravity; also spiral chutes and pneumatic tube systems. Consult STANDARD CONVEYOR COMPANY General Offices: North St. Paul 9, Minnesota. Sales and Service in principal cities.

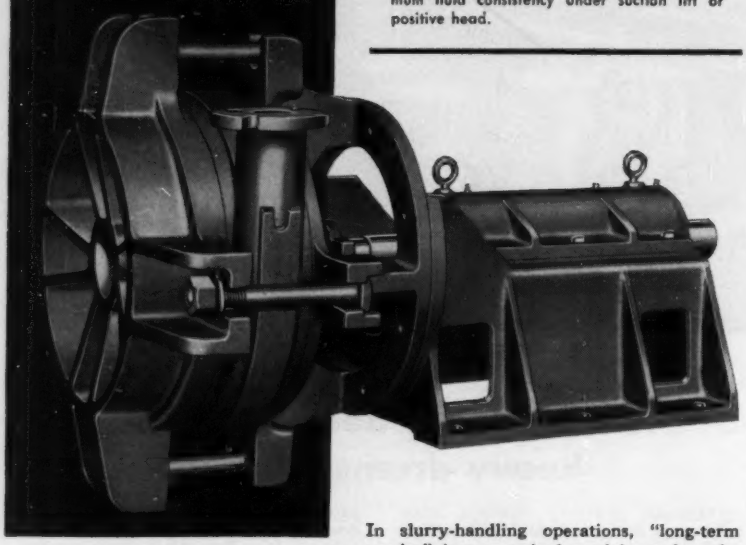
Cut costs, too, in shipping and receiving operations with Standard portable units, either powered or gravity operated. (Left) HANDIBELT portable powered conveyor unit (right) LITEWATE Sectional Roller Conveyor.

Call the Standard engineer listed in your classified phone book, or write direct for Bulletin 309 — address Dept J-5

Standard 50 years of conveyor experience
GRAVITY & POWER
CONVEYORS
Sales and Service in Principal Cities.

For Continuous Heavy-Duty Pumping

The Morris Type RX Pump shown below is a heavy-duty, low-speed all metal slurry pump expressly designed to handle abrasive slurries, chemical sludges, plant wastes etc. up to maximum fluid consistency under suction lift or positive head.



In slurry-handling operations, "long-term service" is a meaningless claim unless the pump will work day-in and day-out with a minimum of maintenance time, trouble and expense.

Morris Slurry Pumps—with an established reputation for longer life—also incorporate in their design exclusive features which result in easier installation . . . fewer interruptions to service . . . less overhaul . . . fewer replacements.

MORRIS
TYPE RX
SLURRY PUMP

• Free Service. Morris Engineers will be glad to recommend the pump best suited to your needs for size, capacity, etc. Send necessary data today . . . include request for Bulletin 185.

To Provide Uninterrupted Service...

The gland is under suction pressure only. This reduces leakage and dilution . . . keeps harsh abrasives out of the stuffing box . . . practically eliminates packing troubles.

There are no internal studs or bolts. Caustic and corrosive solutions cannot seep past threads and cause maintenance headaches.

Impeller removed without disturbing the piping. You simply loosen 4 outside clamping bolts and pull off the end cover. This feature alone saves considerable time and labor.

MORRIS
CENTRIFUGAL PUMPS

MORRIS MACHINE WORKS
Baldwinsville, N. Y.
Sales Offices in Principal Cities

LITERATURE . . .

Gears.....Gear Manual includes 76 p. of illustrations, diagrams, definitions, tables, charts & explanations regarding all types of gears. Also a simplified method of calculating hp ratings. Catalog G-655.
444A Philadelphia Gear Wks.

Lighting Equipment, Emergency..... Makes available complete information describing the Dynaseal power bloc (Bulletin No. A-46) and Dynaseal lifetime emergency lighting units (Bulletin No. A-71).
444B Dynaseal Lighting Corp.

Motor Control.....Describes high-voltage, current-limiting, fused starters for co-ordinated control of squirrel-cage, synchronous, wound-rotor and multi-speed motors. Request 12 p. illustrated Bulletin GEA-6331.
444C General Elec. Co.

Motor Starter-Circuit Breakers.....Design, construction & performance of circuit breaker & motor starter Unilets give maximum safety & unparalleled ease of wiring, installation, maintenance. Bulletin BH.
153 *Appleton Elec. Co.

Motors..... Describes newly designed standard & explosion-proof enclosed motors, featuring corrosion-resistant cast iron frames, improved winding insulation & heavy duty ball bearings. Bulletin No. MU-203 & MU-132.
86 *Wagner Elec. Corp.

Motors.....Describes U. S. Motors—a brief presentation of the complete line. Includes data on: U. S. Uniclosed motors; U. S. Varidrive motors; U. S. Syncrogear motors; U. S. Verticlosed motors; etc. Form F-1878.
444D U. S. Elecl. Motors.

Motors.....Howell part winding motors offer low cost 2 or 3-step starting. For full information—current & torque data for horsepowers from 5 to 200 hp as well as typical installation data—see Bulletin No. PW-1.
444E Howell Elec. Motors Co.

Motors, Flat-Type.....Full horsepower in less space, reduced weight, standard radial construction, easy to disassemble and reassemble, no precision alignments or complicated air-gap adjustments. Bulletin CE-3461.
243 *Diehl Manufacturing Co.

Motors & Generators.....A complete line of motors and generators designed to meet product requirements is illustrated in a new available literature reference. Request "A Company With A Future Invites You."
444F Marathon Elec. Mfg. Corp.

Packings & Gaskets.....J-M Chempac-Interlocked packing combines both teflon and asbestos protection . . . resists virtually all chemicals. Descriptive reference furnishes complete data. Folder PK-80A.
444G Johns-Manville.

Packings, Saddle . . . . . Packs without "nesting", surface area is exposed area, more uniform free space, better liquid distribution, better drainage, less weight. Full technical data in Bulletin S-29.
265 *U. S. Stoneware

Packings, Tower.....Illustrated Folder describes Tellerette . . . a new polyethylene tower packing based on the principle of interstitial hold up. Feature increased efficiency & capacity, lighter weight, etc.
444H Harshaw Chem. Co.

Reducers.....Chemiseal Reducers No. 3-CRS are one piece assemblies, designed to connect unlike pipe sizes with minimum length requirements. Write now for Bulletin No. 3-CRS.
319e *U. S. Gasket Co.

Reducers, Motor.....Motors can be interchanged or replaced in minutes with the all-steel Falk motoreducer. Replacement is not limited to original make of motor. For more information, request Bulletin No. 3100.
444I Falk Corp.

* From advertisement, this issue

Seals, Mechanical . . . . . Reduce your liquid handling costs with types 1 & 2 to type 9 seal, that can be adapted to your individual conditions. Company offers information in its Seal Catalog.
309 *Crane Packing Co.

Transformers, Arc Furnace . . . . . Features: tap changers, core-type construction with inherently strong circular-concentric windings, dust-tight bus-bar seal, etc. For details, request Bulletin GEA-6236.
16 *General Electric Co.

Transformers, Control.....Illustrated, 32 p. describes complete line of G-E control transformers. Includes autotransformers, machine tool transformers & special application models. Request Catalog GED-2767.
445A General Elec. Co.

Transmission Equipment, Power.....Illustrated, 24 p. describes line of power transmission equipment. Includes: variable speed pulleys; wide v-belts; sheaves; motor bases; countershafts; Select-O-Speed Transmission.
445B Lovejoy Flexible Coupling Co.

Turbines, Solid-Wheel.....Feature reliable, trouble-free operation. Rugged construction and superior design result in savings by keeping maintenance costs down to a minimum. Full details in Bulletin No. S-116.
393 *Terry Steam Turbine Co.

Turbines, Steam.....Turbines range from 150 horsepower down to fractional in 6 frame sizes. Feature large number of manually operated valves for individual control of steam nozzles. Details in Bulletin 135.
45 *Coppus Engrg. Corp.

Handling & Packaging

Belting, Conveyor.....For hauling capacity tonnages of coal, ore, rock & gravel to greater heights . . . over longer distances, use practical, low-cost Super Raynile conveyor belting. Details in Folder No. H-21.
445C Hewitt-Robins.

Bins, Bulk Material.....Vertical or horizontal styles are available for any plant layout. To improve your plant's bulk storage & handling request copies of Bulletins 529 & 549.
432 *Day Co.

Buckets.....Illustrated, 24 p. covers 2, 3, & 4 line Clamshell Buckets. Includes classified tables of some 60 different sizes of buckets, containing wt., dimensional & capacity data. Bulletin 2378-R.
445D Blaw-Knox Co.

Bulk Material Body.....New Baughman Model SF-5 Bulk Material Body with full hydraulic operation offers its user faster delivery, bigger payloads and less maintenance. Illustrated Brochure furnishes full details.
445E Baughman Mfg. Co.

Carriers, Straddle.....Company announces a straddle carrier with load hooks which pivot inward to permit carrying without bolsters. Describes outstanding advantages and specifications in illustrated Folder.
445F Clark Equipment Co.

Caustic Soda Handling.....72 p. Handbook covers proper methods of handling, storing, preparing & using water solutions of caustic soda. Data given in a form to facilitate its interpretation with minimum effort.
445G Diamond Alkali Co.

Drums, Magnetic.....For the automatic removal of tramp iron or ferrous material from gravity or conveyor transported products. Includes diagrams, performance data, application guides, etc., in Bulletin MD-200.
445H Homer Mfg. Co.

* From advertisement, this issue

Newark Wire Cloth is made of *all* malleable metals such as aluminum, brass, bronze, phosphor bronze, copper, monel, Nichrome, nickel and stainless steel; as well as the noble metals such as gold, silver, platinum, etc.

This wide range of metals enables you to select the one wire cloth to meet your conditions of corrosion and/or contamination.

In all metals, Newark Wire Cloth is accurately woven in a wide range of meshes, ranging from very coarse (4 inch space cloth), to extremely fine (up to 400 mesh). Our reputation for 'Accuracy' through more than 75 years is your guarantee of wire cloth quality.

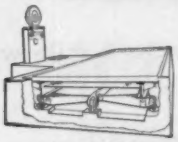
We maintain a large stock of popular sizes in the more commonly used metals and can make prompt shipment. Let us quote on your requirements.

Send for our New Catalog E.

Newark Wire Cloth COMPANY

351 VERONA AVENUE • NEWARK 4, NEW JERSEY

When you STUDY COSTS it pays to take a plant-wide look at WEIGHING



WEIGHING

COUNTING

ELECTRONIC RECORDING

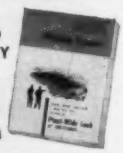
TESTING

A MODERN WEIGHING SYSTEM can make a big difference in cost control and profit in your plant!

Are scales missing where needed? Are over-worked scales making bottle necks in your production? Are you losing material and time with scales misfitted to their jobs? In this day of highly specialized machines and methods, your scales should add up to a *Weighing System* . . . the right scales in the right places . . . supplying basic data for your accounting *system*. These records that originate at scales directly affect costs, inventories and customer billings. Weighing today is not a job for isolated scales—it's a vital part of your overall cost-control system.

If you would like to look further into this in your plant, why not drop us a line today? No obligation, of course. Ask for Booklet 2036. Toledo Scale Company, Toledo 1, Ohio.

SEND TODAY



TOLEDO®

HEADQUARTERS FOR SCALES

LITERATURE . . .

Feeders, Volumetric ..... Volumetric feeders of simple design and rugged construction, easily adapted to installations requiring proportional pacing by auxiliary meters. Describes feeders in Bulletin 45-H8.
446A Omega Mach. Co.

Feeders, Weigh.....Exact Weight weigh feeders help produce a more uniform product, reduce rejects to a minimum and effect a great saving in material. Complete data on weigh feeders for plastic molding.
446B Exact Weight Scale Co.

Idlers, Suspension.....Covers neoprene belt conveyor idler of cable suspension type which resists most chemicals, has excellent resistance to abrasion, does not deteriorate in oil, etc. Bulletin No. LD-103E.
446C Joy Mfg. Co.

Latex Handling, Synthetic.....Fully illustrated, 8 p. reference includes sections on: shipping of latex; storage of latex; transfer of latex; etc. Request "Storage and Handling of Synthetic Latex," Ref. No. 55-264.
446D Goodyear Tire & Rubber Co.

Magnets, Hopper.....Built in any width desired, magnets efficiently remove tramp iron which causes machinery damage, fires, and product contamination. Ideal for surge-fed application. Bulletin B-204.
446E Eriez Mfg. Co.

Magnets, Suspended.....Rectangular suspended separation magnet cures tramp iron headaches on fast-moving conveyers, particularly when material is wet. Find complete products information in detailed Bulletin 25D.
446F Stearns Magnetic.

Material Handling Methods....."Methods & Ideas" illustrates 48 manhour & space-saving handling operations, & shows various types of Barrett material handling equipment at work. Request Bulletin No. 552.
446G Barrett-Cravens Co.

Materials Handling, Bulk.....Fully illustrated Folder describes case studies covering bulk handling of flour, sugar, cake mixes, carbon black, phosphor powders, cement, and 17 other basic materials.
446H Tote System.

Materials Handling, Bulk-Flo.....Equipment designed to reduce handling costs on wide range of materials. Features ability to feed, convey, elevate in one compact, fully enclosed assembly. 28 p. Book 2475.
13 *Link-Belt Co.

Packers, Bag.....Fully illustrated, 12 p. describes Stoker bag packers . . . designed to handle powdery, granular or pelleted materials. Includes outstanding features, operation, applications, attachments, etc.
446I H. L. Stoker Co.

Scales, Automatic Bagging.....Fully describes the Richardson Model E-50 automatic bagging scale. Includes details of its numerous features, tested design, operation, capacity, etc. Request Bulletin 3749A.
446J Richardson Scale Co.

Scales, Checkweight.....Describes new checkweigher utilizing flexual platform with strain-gage load cell weight transmitter and integrally mounted belt conveyor. Features, applications, etc. Catalog 21.
446K Weighing Components.

Scoop, Power, Automatic.....Cuts loading time 30 to 50%, light in weight, easy forward and backward motion, one-man operation, no slack in cable assuring greater safety. For complete details write for Bulletin 863.
152 *Jeffery Manufacturing Co.

Separators, Magnetic.....Type K magnetic separator provides powerful magnetic field which attracts feebly magnetic particles. Purifies & concentrates bulk chemicals where other methods fail. Bulletin No. 701B.
64 *Stearns Magnetic.

* From advertisement, this issue

Separators, Magnetic.....Emerson magnetic separator utilizes powerful, permanent magnets ingeniously arranged for high efficiency—has no moving parts—requires no extra power—is easily cleaned—etc. Full data.
447A Emerson Mfg. Co.

Sodium Handling, Metallic.....Illustrated. 44 p. brochure. "Handling Metallic Sodium On A Plant Scale," contains data such as details of typical sodium-using processes; details of equipment installation, insulation.
447B U. S. Industrial Chem. Co.

Tractor-Loaders.....Low carry, short turning, high lift, more output on every materials handling job. Hydraulic torque converter drive, clutch-type transmission. Arrange for demonstration on Model No. TL-10. Catalog.
157 *Tractomotive Corp.

Trucks, Industrial.....The L-S Jackstacker is the most flexible and easiest to operate "walkie" in the field. Comes in straddle-type, pallot, platforms, etc. Catalog No. 34.
375 *Lewis-Shepard.

Trucks, Industrial Lift.....Illustrated Folder describes new KGA51 series of industrial lift trucks with Yale Torque Transmission Features: greater driver efficiency; smoother operation; longer truck life; etc. 4 p.
447C Yale & Towne Mfg. Co.

Trucks, Straddle.....Offers a straddle type tiering truck in 4000 lb. capacity. Increased capacity made possible by adoption of a heavy duty frame, tandem load wheels, special thermal controller motors, etc. Bulletin 831.
447D Raymond Corp.

Vibratory Equipment.....Electro-permanent magnetic Hi-Fi vibratory equipment needs no rectifier. Operates at 3600 CPM directly off an AC line. Units are automatically self-adjusted. Request data.
233 *Eriez Mfg. Co.

Weighing Systems.....Supply basic data for your accounting system. Records that originate at scales directly affect costs, inventories & customer billings. For complete details request, Bulletin 2036.
446 *Toledo Scale Co.

Heating & Cooling

Boilers, Packaged.....Bros packaged boilers fulfill all steam requirements in the medium pressure range. Offer high steam generating efficiencies with economy of installation & low maintenance costs. Form WT-7.
447E Wm. Bros Boiler & Mfg. Co.

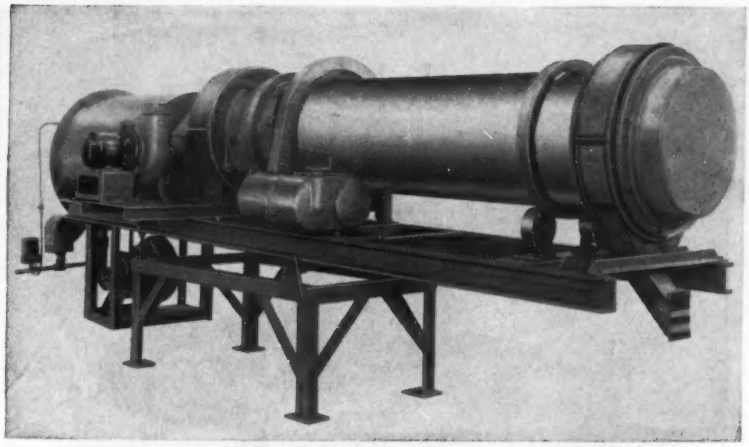
Coolers.....Fuller coolers are handling materials such as pebble lime, dolomite, iron nodules & Portland cement with efficiency. For details, request your copy of Bulletin No. CO-5.
46 *Fuller Co.

Coolers.....Illustrated reference describes air & gas aftercoolers. Cool & remove water vapor & oil from compressed air. 125 to 7500 cfm capacity. Covers features, specifications, etc. Bulletin No. A-27.
447F Joy Mfg. Co.

Coolers, Cascade.....Designed for cooling corrosive liquids and gases. Low initial cost and maintenance, radiused returns for low pressure drop as well as redwood waterguide strips. Catalog Section No. S-6820.
349f *National Carbon Co.

Furnaces.....Makes available a new technical bulletin describing furnaces for the heating and heat treatment of aluminum and other light metal alloys from the ingot to the finished products. Bulletin No. SC-171.
447G Surface Combustion Corp.

* From advertisement, this issue



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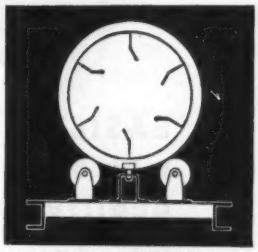
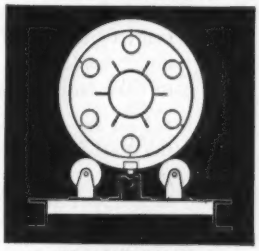
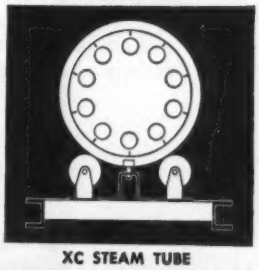
- **Has removable "knockers."**
- **Provides for easy changing of shell rotation speed or shell slope.**
- **Is available in stainless steel or other corrosion-resistant materials.**
- **Requires only fuel supply and power connections to be placed in operation.**
- **Is easily moved from place to place.**



XH-XF SINGLE-SHELL



XB DOUBLE-SHELL



XC STEAM TUBE

It is available in three models:

(1) XH-XF single-shell, direct gas fired dryer. Arranged for either parallel or counter-flow operation. Bulletin AH-471.

(2) XB double-shell, indirect-heat, gas-fired dryer for drying without contamination. Volatiles removed with only limited dilution. Bulletin AH-472.

(3) XC steam-tube indirect heat dryer. Can be connected to any available steam supply or furnished with a 3-HP steam generator. Bulletin AH-473.

***For complete information write Department* 11**

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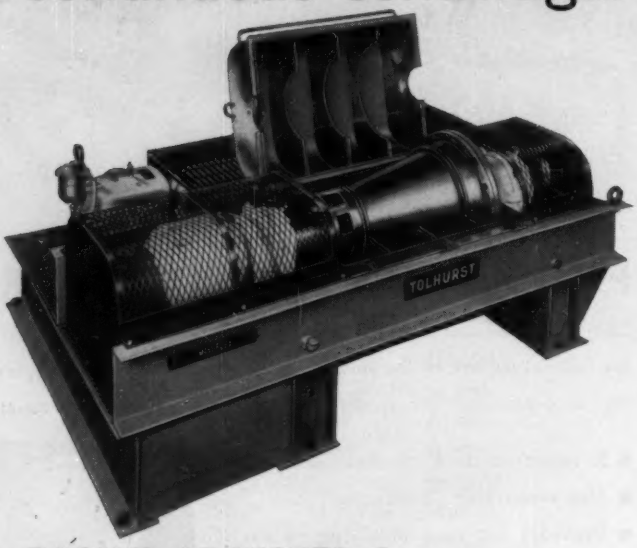

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You can quickly adjust Maxi-Flex® for percentage of solids, cake resistance and mother liquor viscosity. You can easily vary the centrifugal force field and length of time solids and liquid are under centrifugal force. And you can even adjust for dryness of cake and clarity of filtrate as well as best discharge rates.

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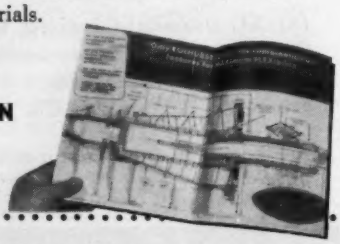

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LITERATURE . . .

Generating Equipment, Steam.....Company specializes in design & manufacture of steam generating equipment. Line of watertube boilers give top performance because of balanced design features. Form No. WT-4.
448A Wm. Bros Boiler Mfg. Co.

Generators, Steam.....16 p. book gives capacities, dimensions, construction features, instrumentation, accessories, sectional drawings & installation photos on new series of steam generators. Bulletin PG-55-3.
49 *Foster Wheeler Corp.

Generators, Steam.....Describes the pre-engineered, standardized steam generators offered in 9 sizes, with capacities of from 50,000 to 150,000 lb. per hr. Includes drawings & design features. Bulletin B-55-4.
448B Foster Wheeler Corp.

Generators, Steam.....Illustrated, 14 p. describes Titusville Type WTP shop-assembled Water Tube Steam Generators. Includes technical data, a dimensional drawing with table of dimensions, etc. Bulletin 5511.
448C Struthers Wells Corp.

Heat Exchangers.....Describes how equipment offers: chemical resistance to practically all corrosive fluids; resistance to severe thermal shock; high heat-transfer rates; low maintenance; etc. Catalog S-6740.
349d *National Carbon Co.

Heat Exchangers.....Covers complete line of Karbate brand impervious graphite shell & tube heat exchangers. Engineered for maximum corrosion resistance & minimum maintenance. Catalog Section No. S-6800.
349e *National Carbon Co.

Heat Exchangers.....Pyrex brand glass shell and tube heat exchanger gives complete corrosion protection; nothing to corrode; compact; cleaning problems disappear; economical; etc. Request descriptive literature.
383 *Corning Glass Wks.

Heat Transfer Apparatus.....Votator heat transfer apparatus can improve efficiency and product quality in numerous processes. Company makes available a Heat Transfer Data Book containing complete information.
2 *Girdler Co.

Heat Transfer Apparatus.....Illustrated booklet provides valuable data on Young heating and cooling coils, air conditioning units, baseboard convectors, unit heaters, convectors, etc. Request your copy of Catalog 256.
448D Young Radiator Co.

Heat Transfer Surfaces.....Brochure contains engineering data and application information on Inner-Fin surface . . . applicable wherever any type of heat exchange is required. Illustrated Bulletin No. 850.
448E Bush Mfg. Co.

Heaters, Deaerating.....Describes the design, operation & application of heater. Photos & cross-sectional diagrams illustrate construction & versatile manner in which it can be installed. Bulletin No. WC-118.
448F Graver Water Conditioning Co.

Heaters, Distilled Water.....Furnishes complete information on distilled water heater which heats distilled water automatically. Covers construction details and electrical requirements. Bulletin No. 132.
448G Barnstead Still & Sterilizer.

Heaters, Gradiation.....Makes available detailed literature—"Try the Gradiation Heater for Economical Ethylene Production" and bulletin. "Gradiation Heating for Petroleum and Chemical Processing."
374 *Selas Corp. of America.

Heating Systems, Dowtherm.....Furnishes descriptive information on Dowtherm heating systems for processes requiring precision control of high constant temperatures at low pressures, in Bulletin ID-54-5.
127 *Foster Wheeler Corp.

* From advertisement, this issue

Editorial Reprints . . .

● Processes and Costs

1 Chemical Engineering's Flowsheets —150 process flowsheets ($2).
2 Cost Estimation I — 38 articles, 128 pp. of data ($1.75).
3 Cost Estimation II — 12 articles, 48 pp. Apr. '52-Feb. '53 ($1).
48 Cost Estimation III — 17 articles, 80 pp. May '54 ($1.25).
52 Heat Exchanger Design—(75¢).
56 Cost Index—Subject index to 351 cost estimating articles (50¢).
65 Cost Index—Supplement (35¢).
69 Plants & Processes—Reprint from 1955 Inventory Issue (75¢).
71 Water—Treatment for use (50¢).

● Feature Reports

4 Fluid Flow—15 articles ($1).
21 Pumps—How to select (50¢).
22 Process Instrumentation — 48-p. report and 16-p. chart ($1).
25 Size Reduction—(50¢).
26 Petrochemical Processes—(50¢).
28 Solids Feeders—(50¢).
33 Fluidized Solids—(50¢).
34 Heat Technology — Heat production, transport, transfer ($1).
36 Strain Gages — How to use (50¢).
37 Entrainment Separation — Equipment and performance (50¢).
40 Process Piping—Roundup of piping, valves, fittings (75¢).
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47 Mixing—Understand this universal operation, 48 pp. (75¢).
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59 Photochemical Engineering—Uses, processes, reactors (75¢).
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● Materials of Construction

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35 Industrial Plastics — How and where to use (50¢).
38 Stainless Steels — Properties and corrosion data (75¢).
43 Hasteloys B, C, D—Combined Corrosion Forum reprint (75¢).
58 16th Biennial Report—64 p. review: corrosion resistance ($1).

● CE Refresher Series

42 Thermodynamics Principles—(50¢).
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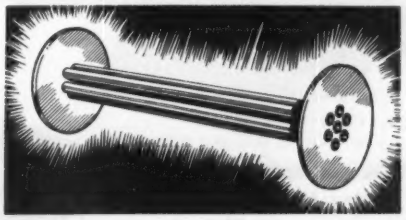
All this is an effort—and so far, it has been a successful effort—to lower processing costs. The benefits of tantalum's complete immunity (not mere resistance) to most corrosive reagents are now obtainable at final operating costs far less than the costs of processing without tantalum.

Why not discuss your corrosion problem with Fansteel engineers for a practical, unbiased recommendation? There is no obligation, and consultations are kept in strictest confidence.

USE TANTALUM WITH ECONOMY for most acid solutions and corrosive gases or vapors.

Not recommended for HF, strong alkalis or substances containing free SO_3.



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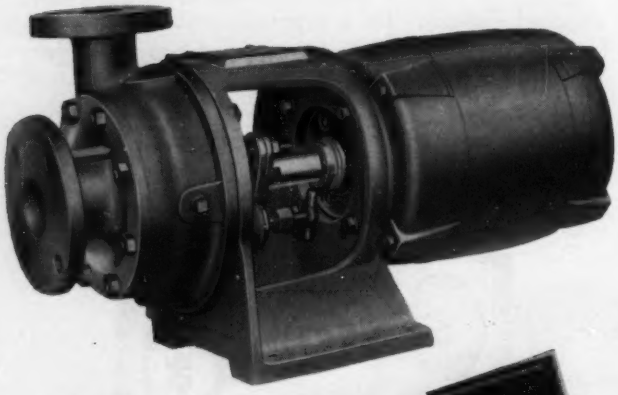
It's a fact that the efficient I-R construction often enables you to use a smaller Motorpump to do the work usually demanded of pumps of greater horsepower!

So, I-R Motorpumps reduce your costs in several ways. First of all, in original cost. Save weight and space, too. Deliver more gallons-per-minute per horsepower used . . . and cut maintenance costs as well, because Motorpumps are built for longer, trouble-free service!

If you're not familiar with the famous I-R Motorpump line you'll do well to get full details right away.



The latest catalog gives complete data needed to choose a Motorpump . . . from ¼ to 75 hp, capacities 5 to 2800 gpm, heads to 650 ft. Write to:

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LITERATURE . . .

Preheaters, Air . . . . . The Ljungstrom boosts products quality & its heat-recovery efficiency makes possible advanced furnace designs that assure close control of processing. For information, request product data.
247 *Air Preheater Corp.

Traps, Steam.....Straight-through steam trap design saves time & fittings for Jones & Laughlin Aliquippa Wks. If you're interested in straight-through piping, request 36 p. book, "Solving Steam Trap Problems."
450A V. D. Anderson Co.

Traps, Steam.....Company's product line features long trap life with infrequent maintenance. Makes available on request a 44 p. Steam Trap Book with practical information designed to give you better trapping.
79 *Armstrong Mach. Wks.

Traps, Steam.....Machined from a solid block of stainless steel, this trap has only 3 parts . . . cap, disc, & body . . . no valve-closing mechanisms. Only moving part is a solid steel disc. Bulletin No. 257.
209 *Sarco Co.

Traps, Steam.....Give faster, more effective condensate removal. Powerful valve action, positive shut-off, high capacity & each unit service tested. For more details, request new Bulletin No. 10-55.
272 *W. H. Nicholson & Co.

Instruments & Controls

Alarms, Flow, Vibration Proof.....F&P has now made it possible to produce the first flow alarm completely insensitive to vibration. For details of the numerous features, request Catalog 10-A-84 (Pub. 11514).
450B Fischer & Porter Co.

Analyzers, Oxygen.....The Unitized O_2 Analyzer can help to streamline O_2-dependent processes. For pertinent information concerning this O_2 monitor, request company's detailed Folder No. ND46-91(5).
56 *Leeds & Northrup Co.

Clutches, Air-Grip.....Bulletin offered by company on its line of air-grip clutches which gives complete technical data, sizes, and selection tables. Request copy of Bulletin A634.
306-7a *Dodge Mfg. Co.

Control, Sequencing Timing.....Used in water treatment plants, chemical & food processing plants, & paper & textile mills to pace chemical feeders & other equipment. Details of systems in Data Sheet 11.12-1.
450C Minneapolis-Honeywell.

Control Systems, pH.....Designed for use in any pH process application—combine in a single package all components needed for single or multiple-channel pH process monitoring, recording & controlling. Bulletin 384.
450D Beckman Instruments.

Controllers, Indicating.....Offers data on new Series 560 controller . . . with revolutionary thermistor principle of operation for kilns, ovens, furnaces, extruding, air heaters, etc. See Catalog No. 500 for details.
87 *Fenwal, Inc.

Now turn to the back . . .

Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the products.

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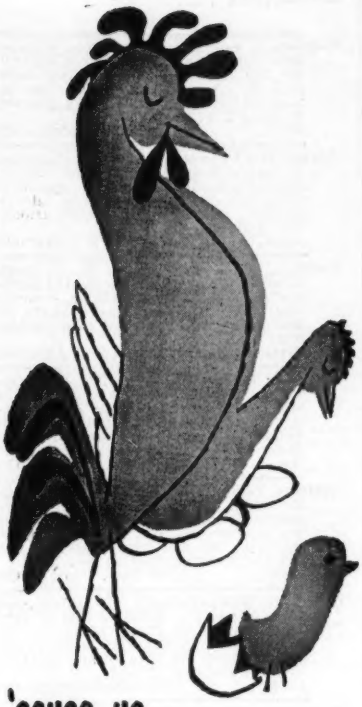

'scuse us for being chesty, but...

. . . we just can't help crowing about reader-response to CE's *Annual Inventory Issue.*

A chemical engineer from Brooklyn calls it . . . *"invaluable already, and without precedent."* A South Carolina plant manager stopped in to tell us . . . *"Yo'all done yo'self real proud."* A Dallas man swears . . . *"the editor musta come from Texas."*

Others went into greater detail—on content, arrangement of editorial sections, Reader Service—even the quality of the advertising. Comments and opinions were all over the lot. And they're still coming in.

What do you say? It's your magaziné and we're wide open for suggestions. We'd like your ideas . . . for the *1956 Annual Inventory Issue* of CHEMICAL ENGINEERING.

ANNUAL INVENTORY ISSUE

Chemical Engineering

ABP ABC

A McGraw-Hill Publication, 330 W. 42nd St., New York 36, N. Y.

This Ampco Pipe has a ¾" wall, to handle sulphuric acid sludge in oil-company operation.

Sulphuric Acid Sludge No Problem

for major oil company,* in 1000-lb. transfer service

Its Ampco Pipe and Fittings resist corrosion

Ampco Pipe successfully handles problem liquids like these:

Boiling sulphuric acid (up to 50%)

Hot concentrated caustic solutions

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**Name upon request*

Many other companies avoid corrosion shutdowns this same way.

Ampco Pipe is made from an exclusive aluminum-bronze alloy that . . .

(a) Resists many acids and caustics.

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(c) Has a Brinell hardness of 150 and tensiles up to 70,000 psi.

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(e) Has high velocity tolerance — flow rates of 18-20 fps.

You can get Ampco Pipe in all standard sizes, many from stock. Fittings are available to 3000 psi; flanges, to 5000 psi.

Write us concerning *your* problem.

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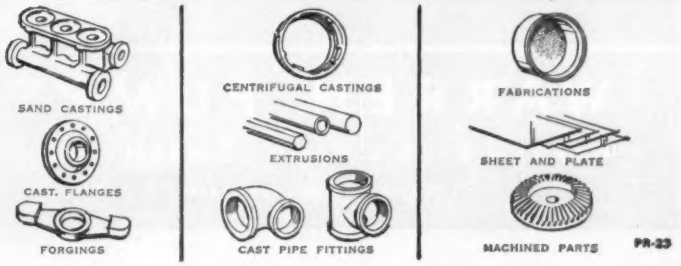

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Preferred for Unusual Applications
WARREN-QUIMBY
Double External Bearing and Gear Hopper Type Pump

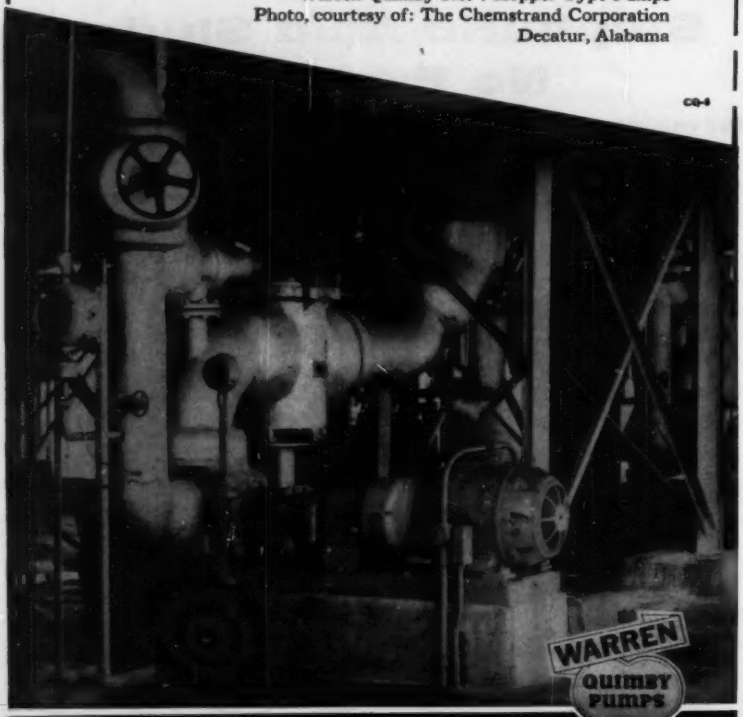
Essentially a unit for handling the most viscous liquids which barely flow and also preferred where it is desirable to mount the pump directly below a tank. This pump is widely used for handling acetates, dopes, tar, soap, sludges, chewing gum, tooth paste, chicle, food products, and where a short, unobstructed suction opening must be provided.

Many applications requiring the filtering of viscous liquids at high pressures up to 1000 P.S.I. are successfully handled with pulseless discharge and without violent agitation or meshing of gears.

Warren-Quimby Hopper Type Pumps are available in stainless steels, acid bronze, nickel and any other machinable metal, in addition to regular cast irons and steels, and with or without body jacketing.

Warren-Quimby No. 4 Hopper Type Pumps
Photo, courtesy of: The Chemstrand Corporation
Decatur, Alabama

CQ-4



WARREN PUMPS
WARREN STEAM PUMP COMPANY, INC.
Warren, Massachusetts

LITERATURE . . .

Controllers, Input.....Describes Wheelco Inputrol—an automatic input controller for accurately controlling input rate of electrical power as well as flow of liquid or gas to any process. Bulletin F 5726-1.
452A Barber-Colman Co.

Controllers, Pneumatic.....Illustrated, 4 p. covers P-4 pneumatic controllers: available modes of control; specifications for controller response adjustments; performance specifications; etc. Pub. No. 11517.
452B Fischer & Porter Co.

Controls, Photoelectric.....20 p. book, "Proved Answers to Successful Automation," offers specifications, descriptive data & operational charts of photoelectric controls for many industrial uses.
452C Electronics Corp. of America.

Controls, Temperature.....Type D5 remote bulb temperature control is a precision unit containing a micrometer adjustment for obtaining wide ranges & accurate temperature settings. Request Catalog Section 200.
298 *United Elec. Controls Co.

Controls, Temperature.....Completely illustrated, 16 p. catalog presents company's line of standard local mounted temperature controls. Includes theory, features, general specifications, etc. Request Catalog Section No. 100.
452D United Elec. Controls Co.

Detectors, Temperature.....Illustrated, 24 p. covers the complete line of 8890 Series Rayotube (heat-radiation) Detectors...for continuous temperature measurement to 5000 F and beyond. Request Catalog EN-S3.
452E Leeds & Northrup Co.

Detectors, Temperature.....The Radiamatic unit is a radiation detector used with an ElectroniK instrument to measure, indicate, record and/or control temperature. For complete information, request Catalog No. 9301.
452F Minneapolis-Honeywell.

Gages.....For pressure, vacuum or compound service. There are no gears or teeth to wear out. Cam wiping action keeps contact points clean & smooth. Provides complete information in Gage Catalog No. G-2.
313 *Helicoid Gage Div.

Gages.....Announces new line of small-size, easy-to-read gages & receivers. Important features: 5 in. illuminated scales; independent, interchangeable units; easily mounted; etc. Data in Bulletin V5.
53 *Republic Flow Meters Co.

Indicators, pH.....Highlights features & component parts of Universal pH Indicator which make it adaptable & accurate for pH measurements in all types of plant & laboratory conditions. Catalog No. EH22-96.
452G Leeds & Northrup Co.

Integrator Systems, Multiple Flow..... Illustrated reference describes company's automatic multiple flow integrator systems. Includes data on the numerous features. Request Catalog 58-30 (Pub. 11520).
452H Fischer & Porter Co.

Meters, Chemical.....Niagara displacement meters measure corrosive liquids accurately. Type 316 stainless steel offer resistance to corrosion. Company offers information on its line.
311 *Buffalo Meter Co.

Meters, Feeders & Controls.....Describes company's extremely varied line of equipment for metering, for chemical feeding and proportioning, and for controlling processes and operations. Bulletin No. B-I-F 5.
452I B-I-F Industries.

Meters, Flow.....F&P 1700 series flowrator meters have rugged enclosure, one basic design, built-in mounting, maximum corrosion resistance, readily available, etc. Details available in Catalog 10-A-25.
241 *Fischer & Porter Co.

* From advertisement, this issue

Potentiometers, Wenner.....Details the application of the Wenner principle, for highly precise measurements of d-c potentials, to the thermocouple potentiometer and the standardizing potentiometer. Catalog EH22(2).
453A Leeds & Northrup Co.

Radiography, Gamma.....12 p. presents basic data required for setting up & operating a gamma-radiography installation; tells how to select proper radioisotope; covers principles of radiation safety. Illustrated.
453B Technical Operations.

Regulators, Jet-Pipe.....Rugged construction, dependability, long life, accuracy, speed, inexpensive maintenance, freedom for use anywhere. Send today for Bulletin No. 139 and 155.
316 *American Hard Rubber Co.

Regulators, Temperature.....Automatic regulators are self-contained & operated by liquid expansion—no outside power is needed. For temperature ranges between 0° & 300°F, pressures to 175 psi. Bulletin 600.
453C Sarco Co.

Spectrophotometers..... Versatile and accurate, the G-E spectrophotometer has a range of 380 to 700 millimicrons. Instrument will measure both transparent and opaque samplings. Data in Bulletin No. GEC-307.
453D General Electric Co.

Spectrophotometers..... Announces the availability of a 12 p., fully illustrated brochure on the Ratio-Recording DK-2 Spectrophotometer with curves, performance characteristics, etc. Request Bulletin No. 377.
453E Beckman Instruments.

Thermometers.....Features: can be installed anywhere; Maxivision dial guarantees accurate reading, & bimetal actuation insures high sensitivity, economy & surety of operation. Request Bulletin 148.
36 *Manning, Maxwell & Moore.

Transmitters, d/p Cell.....Pioneered by Foxboro seven years ago . . . the d/p Cell Transmitter established a new standard of performance in flow measurement and control. Describes design features in Bulletin 13-11.
48-9 *Foxboro Co.

Transmitters, Pneumatic Pressure
The Series 1250 Ashcroft pneumatic pressure transmitter is available with pressure sensing elements in all standard pressure ranges & Bourdon tube materials. Bulletin 340.
275 *Manning, Maxwell & Moore.

Transmitters, Power.....Unequalled for repeated start-stop machine operation. Use of transmitters makes it possible to simplify machines, reduce costs, improve operation, etc. Details in Bulletin No. CE-3303.
453F Diehl Mfg. Co.

Pipe, Fittings, Valves

Couplings.....Releases a revised catalog on Quick-Seal line of quick connect-disconnect hose couplings. Features cutaway views of coupling which reveal its unique design & construction. "Quick-Seal Couplings."
453G Titeflex, Inc.

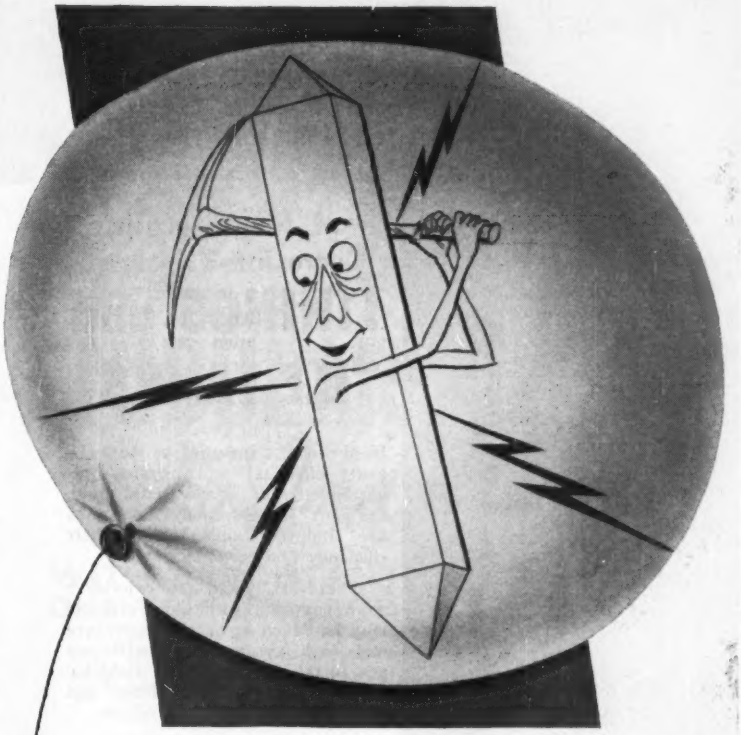
Now turn to the back . . .

Simply circle the code numbers desired on the handy pre-paid postcard, and mail it to us. Replies will reach you direct from the companies manufacturing the products.

* From advertisement, this issue

MH Sodium Hydride

Suspended in Oil is now available!



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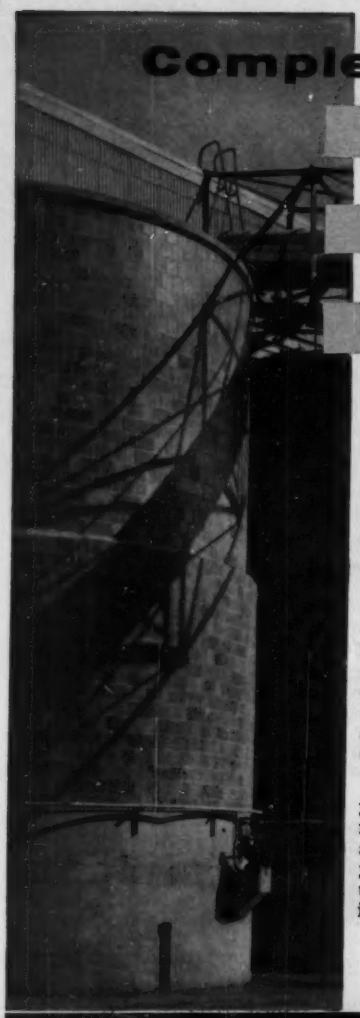

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INSTALLATION
by our own construction crews

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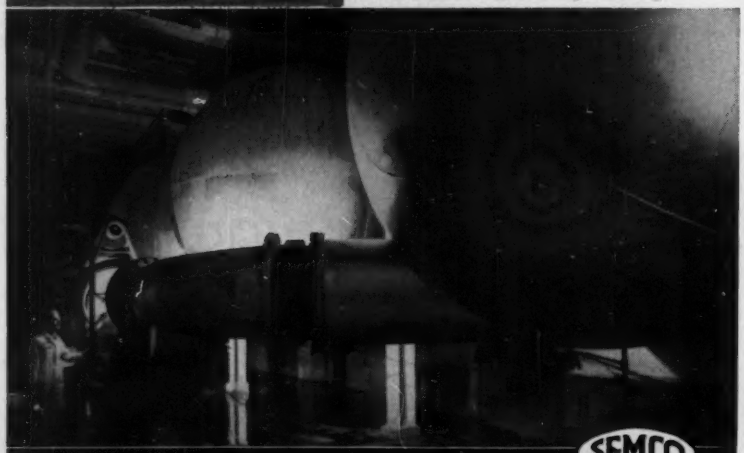
Write for Bulletin A-153

See our Advertisement in Chemical Engineering Catalog



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LITERATURE . . .

Couplings.....Steeliflex couplings offer unique multiple protection for connected machinery—overcome damaging conditions of shock loads, shaft misalignment and vibration. Engineering Bulletin covers details.
92 *Falk Corp.

Couplings, Chain.....Literature available on chain couplings, taper-lock sprockets and Dodge roller chains. Technical data and selection methods. Request your copy of Bulletin No. A644.
306-7b *Dodge Mfg. Corp.

Fittings, Pipe.....Presents newest catalogue of stainless steel pipe fittings which shows all standard pipe fittings and flanges, flanged fittings, butt weld fittings, etc. Request fully illustrated Catalog No. 653.
301 *Camco Products.

Fittings, Seamless Welding ..... B&W fittings are manufactured from seamless steel tubing & are available in alloy, carbon & stainless grades in a wide range of sizes. Grades & size ranges in Bulletin FB-500.
454A Babcock & Wilcox Co.

Hose, Metal, Flexible ..... Company offers a new catalog on its line of hose and tubing. Contains basic information on all types of metal hose and tubing, fittings, etc. Request Reference Catalog CC-400.
224-5 *American Brass Co.

Joints & Couplings.....Teflon expansion joints and flexible couplings absorb shock, vibration, thermal expansion and contraction. Connect unlike piping ends and nozzles. Covers complete data in Bulletin EJ-1155.
319a *U. S. Gasket Co.

Joints, Swing.....Swing joints can be furnished with gaskets for any liquid-handling service in the chemical & processing industries. Details on the 400 series steel swing joints, in new Catalog.
98 *Wheaton Brass Wks.

Pipe & Fittings.....For corrosion-resistant piping. Impervious graphite pipe & fittings readily installed, long lasting, easily maintained, unaffected by most corrosive fluids. Catalog Section No. S-7000.
349c *National Carbon Co.

Pipe, Fittings & Valves, Impervious Graphite.....Fully illustrated 12 p. covers line of Impervite impervious graphite pipe, fittings & valves. Also heat exchangers, pumps, coolers, towers, etc. Catalog No. 965.
454B Falls Industries.

Pipe, Plastic.....Ace Rivivlor is a new rigid threaded plastic pipe with good aging & high impact strength. Not affected by most inorganic acids & alkalis. Excellent for many organics. Request Bulletin CE-56.
314a *American Hard Rubber Co.

Pipe, Plastic.....General-purpose moderately priced rubber-plastic pipe handles most common chemicals to 170° F...except few strong acids & organic solvents. Tough, odorless, tasteless. Bulletin No. 80.
314c *American Hard Rubber Co.

Pipe, Plastic.....Polyvinyl Chloride is the unparalleled material for pastic pipe. It's a high quality unplasticized-rigid pipe designed to do a better job than any other material. The full story in Bulletin 24.
390 *U. S. Steel Corp.

Pipe, Saran Lined.....Saran lined pipe, fittings and valves cut corrosion costs . . . can be cut in the field with available pipe fitter's tools. Liquid never touches metal in saran lined pipe. Request details.
268 *Saran Lined Pipe Co.

Tubing, Plastic.....Excellent chemical-resistant, all-purpose flexible plastic tubing. Sparkling clear, easy to clean, odorless, non-toxic, can be steam-sterilized. For details request Bulletin No. 66.
314b *American Hard Rubber Co.

* From advertisement, this issue

Unions & Fittings.....Describes a broad line of adapter unions, pipe fittings and boss and bulkhead adapter unions. Reference is very complete with dimensional diagrams, and engineering aids. Catalog No. 200.
455A Anchor Coupling Co.

Valves.....Available in 18-8 SMo and Craneloy 20 . . . in gate, globe, angle and check patterns . . . ¼" to 6" . . . screwed or flanged ends. Rated 150 p.s.i. at 500° F. For details, see Circular AD-2080.
293 *Crane Co.

Valves.....Features: non-sticking; no metal-to-metal contact; needs no lubrication; requires no packing; renewable sleeve & plug. Details on type F valve are available. Request copy of Bulletin V/4a.
229 *Duriron Co.

Valves.....There's an Ace hard rubber, rubber-lined, or plastic-lined valve for every corrosion application. Sizes from 2" to 24". Diaphragm, gate and check types. Lists chemicals handled in Bulletin CE-52.
315a *American Hard Rubber Co.

Valves.....Shear-Seal valves catalogued by major service condition: air, oil, water. Three Bulletins include valve characteristics, flow patterns, overall dimensions; etc. Request Nos. A-5, O-5, and W-5.
455B Barksdale Valves.

Valves, Check.....Fast, quiet operation means low cost operation for check valves . . . and that's exactly what the Chapman Tilting Disc Check Valve is designed to do. Data on full line in Catalog No. 30-A.
74 *Chapman Valve Mfg. Co.

Valves, Diaphragm . . . . . Trouble-free plastic diaphragm valves—choice of general-purpose Ace-Ite, Ace Parian (polyethylene) or Ace Saran. Handles most corrosive chemicals & food ingredients. Bulletin 351.
314d *American Hard Rubber Co.

Valves, Diaphragm.....Describes Grinnel-Saunders diaphragm valve with straight-through flow. Includes advantages, maintenance, design, selection of bodies and bonnets, etc. Fully illustrated, 4 p.
8 *Grinnell Co.

Valves & Fittings, Drop Forged Steel .....400 p. book describes complete line of drop forged steel valves, fittings, & flanges for oil, steam, water, air, gas & refrigeration services. Catalog No. F-9.
164 *Henry Vogt Mach. Co.

Valves, Lubricated Plug.....36 p. covers complete line of iron and steel lubricated plug valves available. Many illustrations of singe, screwed and bolted gland type valves are shown. Request Catalog No. PV-4.
216-7 *Wm Powell Co.

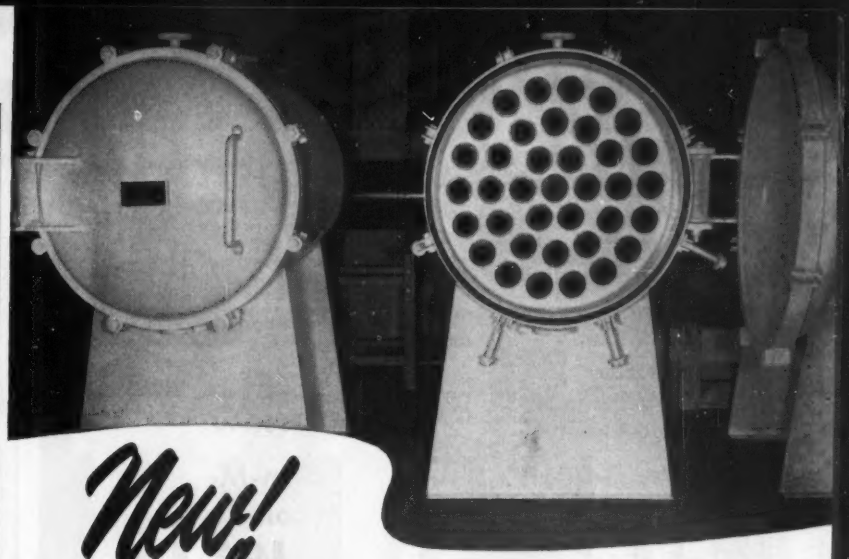
Valves, Manual Reset.....Fireye Series 81G manual reset valves for use in automatically shutting off flow of fuel in oil and gas burners in cases of faulty operation, fully described in illustrated Bulletin CV-31.
455C Electronics Corp. of Amer.

Valves, Packless.....At pressures of 500 psi & temperatures of 1000°F., Sylphon packless valves prevent corrosive or flammable fluids from leaking or creating hazards. For details, see Bulletin 813-JC.
283 *Fulton Sylphon Div.

Valves, Reducing.....A simple air loaded, diaphragm operated, pressure reducing valve that is virtually maintenance-free for steam heat or process steam application. Details in Bulletin No. 561.
276 *Leslie Co.

Valves, Reducing, High Pressure..... Includes photos, a cross-sectional engineering drawing, recommended uses, description of construction & operation features, capacity, rating & sizing charts. Bulletin S-731.
455D A. W. Cash Co.

* From advertisement, this issue



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WITH IMPORTANT NEW FEATURES DUE TO FLOW FROM INSIDE OF TUBE

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The filter is prepared for use by simply rolling flat sheets of filter paper and inserting them in the tubes, which are designed to force the paper snugly against the tube wall.

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Filter papers are simply withdrawn and replaced. Even the tubes are easy to remove, being held in place by a simple rubber O-Ring device. Except for the cover there are no nuts and bolts to handle.

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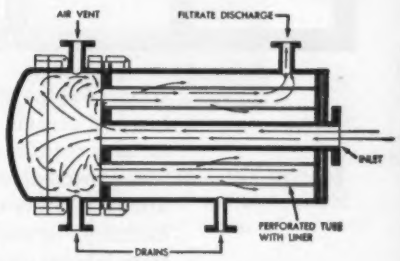

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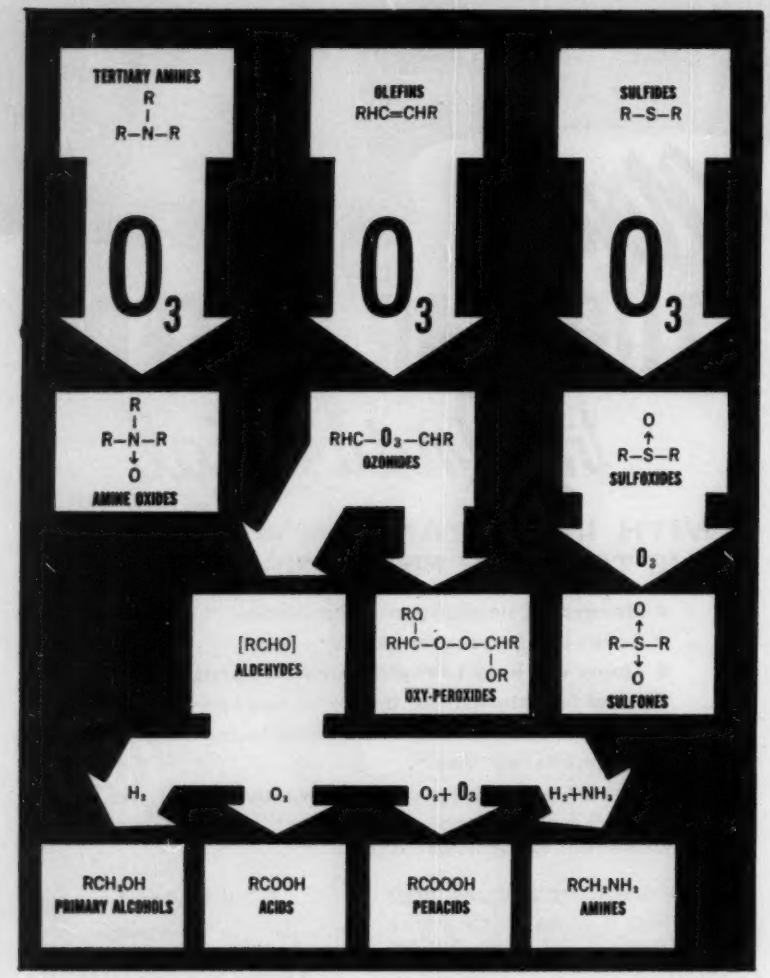

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LITERATURE . . .

Valves, Segregating Slide . . . . . Covers company's line of slide gate type of segregating valves for pneumatic materials handling systems. Includes data on application, design, operation, etc. Data Sheet Ua.
456A Allen-Sherman-Hoff Co.

Valves, Teflon Seated. . . . . Aloyco valves with renewable teflon discs out-last metal-to-metal seated valves. Leakage is prevented because of teflon's ability to seal. Request Bulletin No. 6.
52 *Alloy Steel Products.

Process Equipment

Absorbers. . . . . For absorption of hydrogen chloride and other gases. Produce as much as 20 tons per day 22° Baume acid. Pneumatic automatic control. Complete information in Catalog Section No. S-7460.
349g *National Carbon Co.

Agitating Equipment. . . . . Use Nettco Flomix to combine liquids & solids as they flow through a pipe line. For complete information, company makes available bulletins & data. Nos. 531, 551 & 532.
24 *New England Tank & Tower.

Agitators, Fluid, Packaged. . . . . Offers a new line of packaged fluid agitators . . . plus complete fluid agitation engineering service . . . plus field service—right in your plant . . . etc. Illustrated Bulletin A2-55.
80 *Philadelphia Gear Wks.

Centrifuges . . . . . Toxic, volatile, and odorous liquids can be centrifuged readily at high throughputs. The Sharples super-centrifuges put at your command the highest centrifugal force. Bulletin 1248.
129 *Sharples Corp.

Dissociators, Ammonia. . . . . Illustrated, 12 p. offers valuable information: typical uses of dissociated ammonia; description of dissociator economy; advantages; sizes-capacities; users of equipment; etc. Bulletin B-52.
456B Drever Co.

Dryers. . . . . Full line pressure reactivation, purging eliminated, longer adsorbent life, no moving parts, simple design, all air or gas entering dried without loss. Bulletin 16.0.018.
L327 *J. F. Pritchard & Co.

Dryers. . . . . Lectro-dryers can dry air & gases in volume to dewpoints below —100°F—can, drop relative humidity lower than 10%. Booklet describes machines & how various industries use them to gain efficiency.
386 *Pittsburgh Lectrodryer Corp.

Dryers, Air. . . . . Fully automatic, reactivates every 12 hours (or 22,800 cubic feet of air) and there is practically no pressure drop from the entering pressure. For details, request Bulletin D-100.
51 *C. M. Kemp Mfg. Co.

Dryers, Rotary. . . . . Deliver top production, exacting performance, greater profits. Tells how Standard-Hersey has aided manufacturers throughout the world in solving their dryer problems in illustrated 12 p. Bulletin.
66 *Standard Steel Corp.

Dust Collectors. . . . . New self-cleaning collector offers continuous automatic operation, constant air volume and suction, uniform air flow resistance at low cost. Request Bulletin No. 915.
308 *Pangborn Corp.

Evaporators, Turba-Film. . . . . Evaporators give rapid one-pass evaporation of liquids, slurries and gases . . . especially heat-sensitive substances . . . all by continuous process. Literature available on request.
17 *Rodney Hunt Mach. Co.

* From advertisement, this issue

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Whatever your pipe coil problem is, the chances are we will NOT recommend a pipe coil. Pipe coils are out of date. We will prove that it will cost you less and you will benefit in every other way by using a

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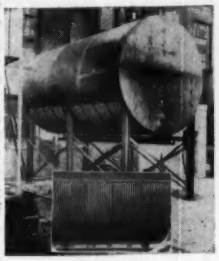
This photograph shows a typical example. In the "old days" tanks of this kind were heated by coils installed INSIDE. Today Dean Thermo-Panel Coils on the OUTSIDE of the tank do a much better and more efficient job at about half the cost.



Bulletin 355 — 52 pages; Price Data Bulletin 256; and advice by our engineers are yours without obligation.

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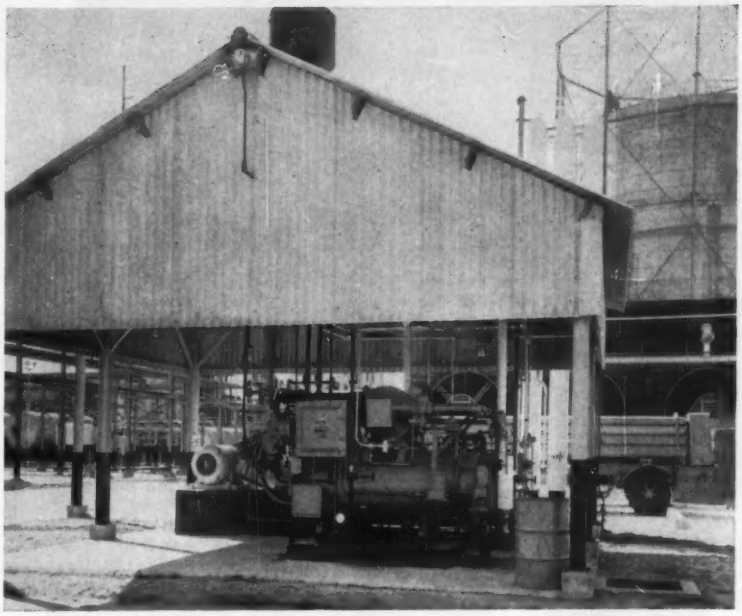

ESSO USES GAS ATMOSPHERES' MODERN INERT GAS SYSTEM

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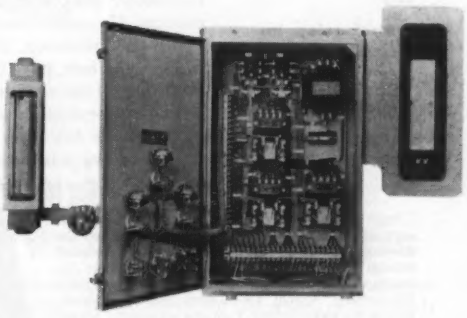
This compact generator unit delivers 10,000 cfh of inert gas. Esso uses the gas to purge lines and tanks before filling with a different material, and for displacing undesirable vapors during process and storage at their large pilot plant installation at Baton Rouge, Louisiana.

The generator is the most modern unit of its kind in the industry. If you, like Esso, want the most modern and economical gas generation equipment possible, then contact Gas Atmospheres first.



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With a Dings Metal Detector "eye-ing" your product, you stop tramp metal trouble before it starts. Tramp metal particles can't pass it unseen to impair product quality — no monkey wrench in the machinery can cause costly damage. Whether your product is in raw or finished condition, in bulk or pressed form, liquid or viscous, granular or fibrous, or in deep, heavy burdens, there's a type of Dings Metal Detector to scan the material constantly, sound the alarm or stop the belt at the first sign of tramp metal.

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- Wide range of sensitivity settings
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- Control relay inside cabinet
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MD-156-½

LITERATURE . . .

Evaporators.....Complete Swenson Catalogue contains full information on long-tube vertical evaporator, spray dryers, crystallizers, forced circulation evaporators & recovery equipment for pulp mills.
277a *Swenson Evaporator Co.

Filters.....All types of continuous rotary vacuum filters . . . string horizontal, scraper, precoat, etc. . . . are custom designed & manufactured by FEInc. Company makes available Bulletins.
75 *Filtration Engrs., Inc.

Filters.....Cuno's new Super Auto-Klean filter now makes possible economical, compact, micronic filtration at high flow rates & eliminates the need for replacement cartridges. Request Catalog SAK-057.
148 *Cuno Engrg. Co.

Filters, Horizontal Vacuum.....Bird-Prayon continuous, rotary, horizontal vacuum filter combines: super efficient multi-stage washing; high operating efficiency; low operating cost. Bulletin No. BP-2-55-5M.
6 *Bird Mach. Co.

Filters, Liquid.....Company offers 12 p. bulletin containing engineering & performance data, photos, descriptions of filtering media, recommended use of each, etc. on its Staynew filter. Bulletin 300.
284 *Dollinger Corp.

Filtration Equipment.....Sperry makes available a catalog complete with charts, tables, & diagrams to help in the operation, maintenance & selection of filtration equipment. Request your copy. Catalog 7-E.
312 *D. R. Sperry & Co.

High Pressure Equipment.....Illustrated, 28 p. describes rapidly expanding line of high pressure valves, adaptors, reactors, autoclaves, thermocouplings, gages, fittings & tubing. Request Catalog No. 2055.
458A High Pressure Equipment Co.

High-Pressure Equipment.....Equipment described in new 100 p. catalog embraces pilot plants, reaction vessels, fittings, valves, tubing, pumps, compressors, instruments, etc. Request Catalog 406-D-34.
458B American Instrument Co.

Homogenizers, Industrial.....Profusely illustrated folder describes the Gaulin Homogenizer. Includes: construction and operation; theory of homogenization; products processed; specifications; etc. Bulletin H-55.
458C Manton-Gaulin Mfg.

Mills, Hammer.....Williams heavy duty hammer mills; increase your output; improve product quality; reduce your cost-per-ton. For complete details of features and advantages, request complete product reference.
99a *Williams Patent Crusher.

Mills Vertical.....Company is presenting compact, high-speed pulverizers which offer an economical means of making super-fine materials to meet today's high specifications. Full details available in Bulletin 78.
294 *Raymond Div.

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* From advertisement, this issue

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Whether it is titanium, magnesium, lithium, zirconium, germanium, calcium, silicon, vanadium, etc. . . . if your process requires vacuum operation, your working vacuum can be reached faster and at lower cost with

BEACH-RUSS
Rotary Vacuum Pumps

The Beach-Russ Type RP Pump is used extensively in processes involving vacuum or inert atmospheres for induction or arc melting, heat treating, alloying or refining. This versatile pump is available in capacities from 20 to 1800 c.f.m. for any laboratory, development or production work. It can be used on either a straight mechanical system, or in combination with a diffusion pumping system for higher vacuums.

The superior design, high efficiencies and slow operating speeds make the Beach-Russ Type RP Pump the best available mechanical pump for your work. Catalog 90 tells the full story.

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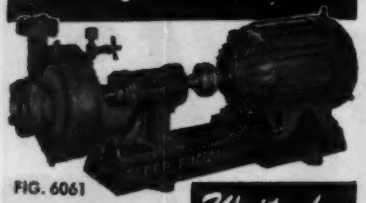

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357 Yarnall-Waring Co.

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460C Spencer Turbine Co.

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460D Chicago Blower Corp.

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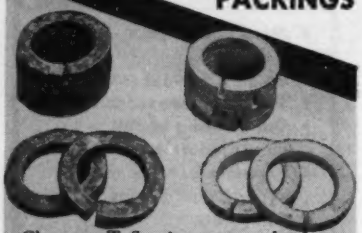

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349b *National Carbon Co.

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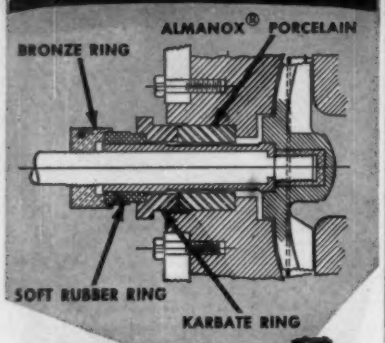

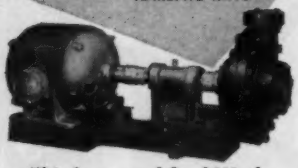

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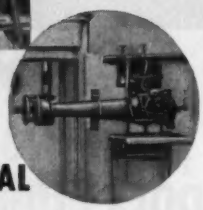

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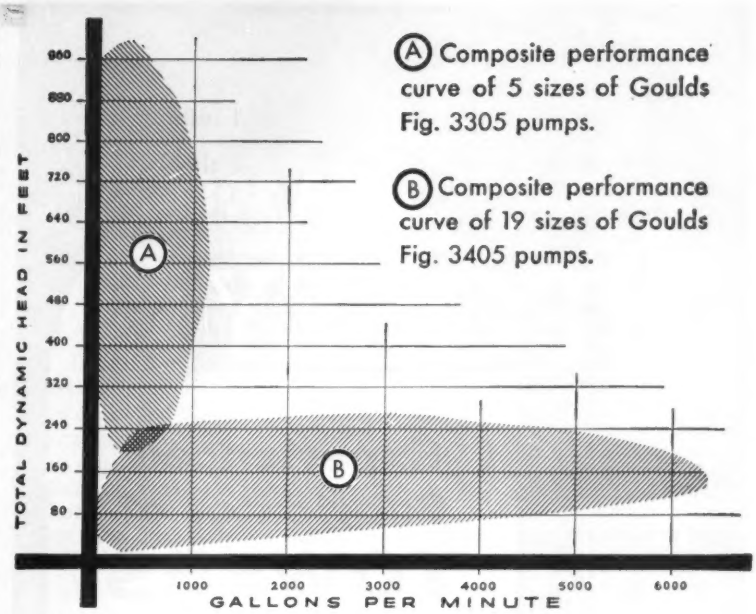

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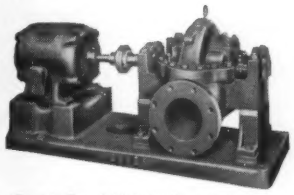
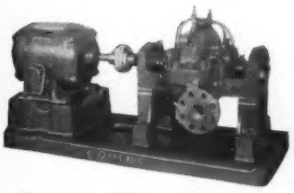


Goulds Fig. 3405 single stage pump.



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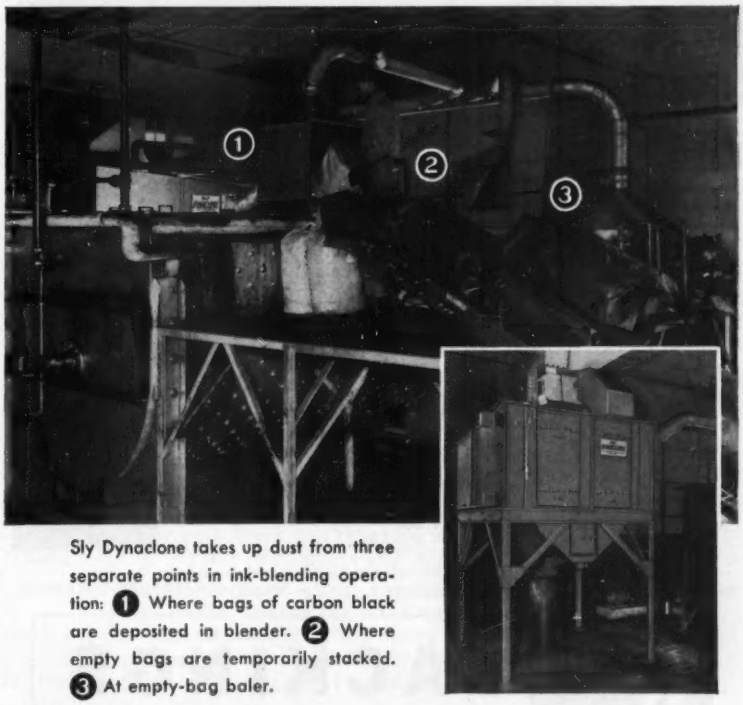

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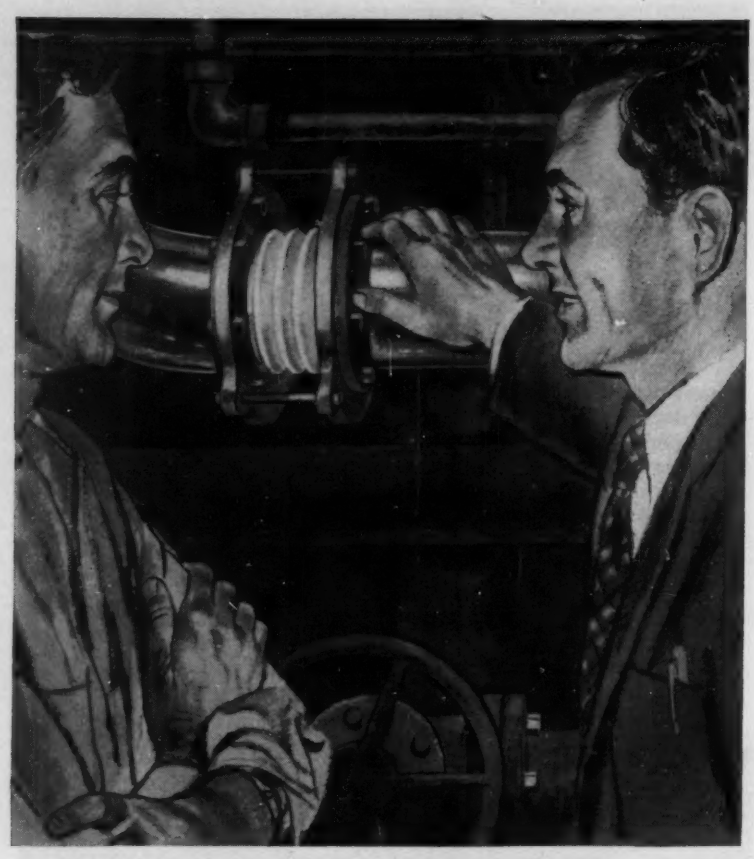

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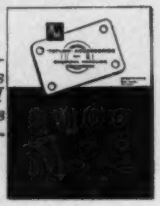

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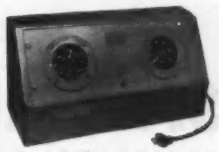

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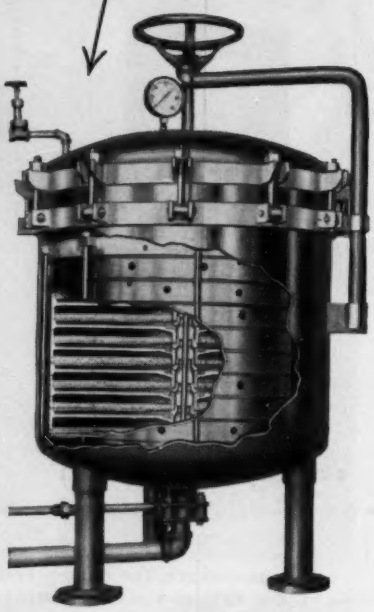

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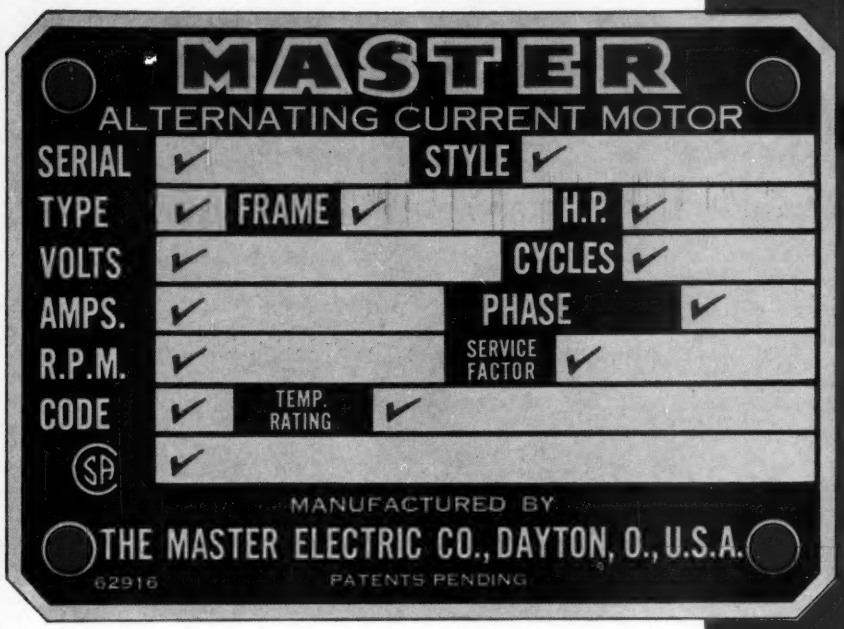

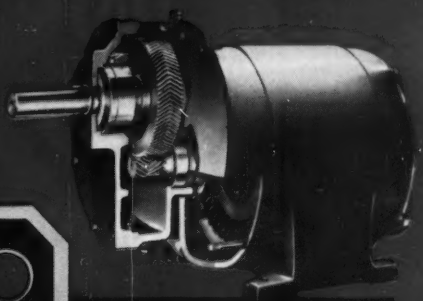
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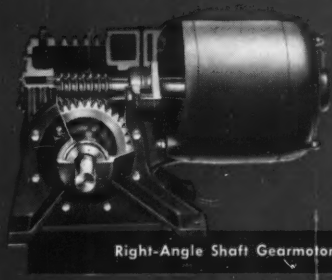
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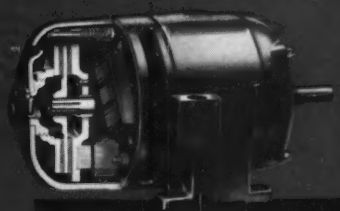
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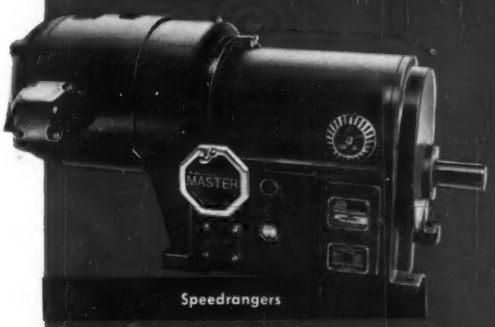
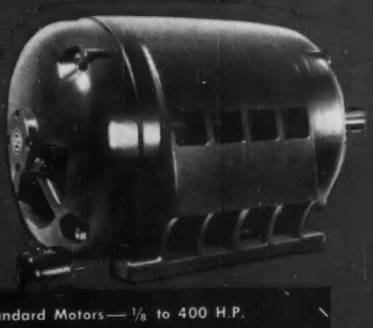


Speedrangers


Standard Motors— 1/8 to 400 H.P.

What are your power drive requirements? Here at Master, with the widest selection in the nation to choose from, you're sure to fill your needs quickest and best.

Need something special in gear reduction—electric brakes—variable speed operation—fluid drive or special mounting? Or would some of our standard models (1/8 to 400 H.P.) fill the bill? You'll find the answer here! And remember, all Master components are engineered to form combinations of units in one streamlined, compact package of efficiency. Name your need and the name that fills it is Master—for greater salability of motor driven products; for increased productivity of plant equipment.

Motor Ratings..1/8 to 400 H.P. All phases, voltages and frequencies.

Motor Types.....Squirrel cage, slip ring, synchronous, repulsion-start induction, capacitor, direct current.

Construction ....Open, enclosed, splash-proof, fan-cooled, explosion-proof, special purpose.

Speeds .....Single speed, multi-speed, and variable speed.

Installation .....Horizontal or vertical, with or without flanges and other features.

Power Drive Features .....Electric brakes (2 types)— 5 types of gear reduction up to 432 to 1 ratio. Mechanically and electronically-controlled variable speed units—fluid drives—every type of mounting.

THE MASTER ELECTRIC COMPANY
DAYTON 1, OHIO

Corrosioneering News

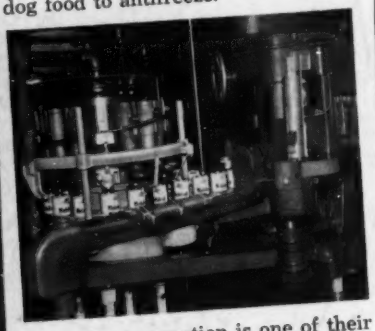
Quick facts about the services and equipment Pfaudler offers to help you reduce corrosion and processing cost.

Fills 500 quarts/min. gives you clean package

You can package any free flowing or semi-liquid lubricant at high speed on Pfaudler rotary piston filling machines.

In fact, *any* product that can be handled in stainless steel and that is of a viscous nature can be filled – at speeds up to 500 cans per minute.

These fillers are in use on a great number of products, ranging from dog food to antifreeze.



Low-cost operation is one of their biggest drawing cards. Operating on a very simple piston principle, they have very few parts, require a minimum of adjustments, and are remarkably easy to clean.

For cleaning, one man does the job in a matter of minutes, simply by removing two parts from each piston. He needs no tools to do the job.

There are no piston rings to handle, no connecting rods or wrist pins to wear out. And for long life without trouble, all gearing is totally enclosed in an oil bath.

To keep your filling operation economical and tidy, you can adjust the amount of fill to within ± 1/10 of an ounce, just by turning a single screw. You don't even have to stop the machine.

Other important features include no-can-no-fill mechanism, screw infeed for accurate timing of containers, adjustable legs to compensate for uneven floor. Four models available: RPL-6 (6 pistons), up to 175 containers per minute; RPL-7 (for large cans), 100 cpm; RPL-14, 350 cpm; and RPL-21, 500 cpm.

Containers may be metal, glass, plastic, fiber or paper, in almost any imaginable shape.

AGITATOR CHANGEOVER CUT TO MINUTES!

It takes just a few minutes, one man and two tools (a strap wrench and socket wrench) to assemble the new Pfaudler separable blade glassed agitator!

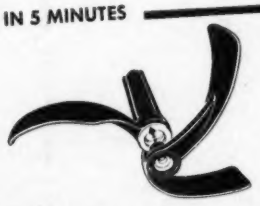
Assembled *inside* the reaction kettle, this agitator eliminates the need for a big agitator opening in the top head, and permits easy changing or replacement of impellers. This opens the way to improved agitation, since size of impeller now becomes an easy variable.

Designs will be furnished in four sizes: 36", 44", 50" and 54" blade diameters. Production units will be available at a later date, to be announced.

(Patents pending)

IMPELLER BLADES GO ON IN 5 MINUTES

1. Place Teflon-enveloped gasket in position, then place double-blade assembly over it.



2. Insert single-blade assembly, separated from double-blade assembly by another gasket.

3. Place and tighten hex bolt with socket wrench.

4. Add the third gasket, followed by glassed cap piece. Tighten cap piece with strap wrench.

Free booklet shows how to scale up to pilot production

A new booklet, Bulletin 927, has been published by Pfaudler to give you full details on a series of glassed steel reaction kettles that permit perfect scale-up from 5 to 100 gallons (at which point a larger Pfaudler series takes over and permits scale-up to full production).

Using acid-alkali-resisting glass, these vessels not only provide accurate scale-up within their own series, the Pfaudler "P" Series, but they also give the same properties as the glass beakers and other vessels used in the laboratory.

They handle a broad variety of products, and have versatile multipurpose agitation. They are obtainable for rated pressures up to 150 psi, and temperatures up to 600° F.

For complete specifications, sizes, photos, and descriptions, mail the coupon for your copy of Bulletin 927, "Pfaudler Type P Glassed Steel Reactors."

Pfaudler THE PFAUDLER CO., ROCHESTER 3, N. Y.